T A B L E O F C O N T E N T S

Trouble-shooting instructions	:	PEU-5001
BOSCH system	:	EI-K
Make of vehicle	:	Peugeot
Basic microcard	:	PEU-505

SPECIAL FEATURES

These trouble-shooting instructions are valid at the time of publication for the following Peugeot model:

* 505 Turbo Injection with intercooler
  USA 05.85 ->

* Electronic ignition system with knock control (EI-K).

* Control unit 0 227 400 033 with self-diganosis (only knock control).

* Second full-load signal, under continuous knock, from EI-K control unit term. 15 to LU-Jetronic control unit term. 15, in addition to full-load signal from EI-K control unit term. 18.

* Only voltmeters with R_i > 100 k Ω /V and resolution of 10 mV may be used for adjusting the rotational angle sensor.

STRUCTURE; USAGE

These brief instructions cover essentially vehicle-specific special features and test specifications (set values).

Corresponding to the customer complaint, the trouble-shooting chart points to different causes of trouble/component faults.
Detailed information for trouble-shooting must be taken from the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features in these vehicle-specific brief instructions are a l w a y s binding.

SAFETY AND PRECAUTIONARY MEASURES

Keep people out of danger.
Avoid damage to engine, control unit or ignition system.

* C A U T I O N !
  High-output ignition system.
  Dangerous high and low voltages.

  Do not touch voltage-conducting parts or terminals; danger to life at primary and secondary sides.

* When testing the compression, disconnect the trigger-box plug or apply ignition coil term. 4 firmly to ground using auxiliary cable.

  Note:
  Auxiliary cable must be interference-suppressed with at least 2k Ω .

See basic instructions for further precautionary measures.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with great difficulty
2. Engine starts but then dies
3. Idle problems (engine speed, exhaust gas)
4. Poor throttle response, progression fault
5. Engine misfiring (ignition, injection)
6. Maximum engine power/top speed not reached
7. Fuel consumption too high
8. Engine runs on
9. Engine pings/knocks
10. Engine becomes too hot
11. Fault indicator lamp

1	2	3	4	5	6	7	8	9	10	11	Cause (component fault)
										*	Self-diagnosis
*		*	*	*	*	*					Spark plugs
			*	*	*	*					Interference-suppression resistors
*		*	*	*	*						Shunt on secondary side
*		*	*	*	*						Open circuit on secondary side
*											Open circuit on primary side
*		*	*	*	*						Ignition coil
*											Firing sequence
			*		*	*		*			Idle switch
*		*	*	*	*	*		*	*		Ignition basic setting
					*	*		*	*		Full-load signal
*											Voltage, trigger box
*											Voltage, EI-K control unit
*											Magnetic pulse generator
					*	*					Abnormal engine noises
								*			Fuel quality

SELF–DIAGNOSIS TEST TABLE

Fault ind. Flashing code	Cause of trouble	Test instructions	Term–inals	Set values
1	Continuing knock	Check cooling system, check ignition–distributor mounting position Octane rating of fuel too low. Continuity test, EI–K control–unit plug to LU–Jetronic control–unit plug	 15 15	 Approx. 0 Ω
2	EI–K control unit voltage supply	Ignition ON. Voltage, EI–K control–unit plug Voltage correct: replace EI–K control unit. Voltage too low: check voltage drop from battery to EI–K control–unit plug (engine at idle)	6 , 20 (+) (–) B– , 20 B+ , 6	Approx U_B Max. 0.5 V Max. 0.5 V
3	EI–K control unit	Knock control defective, replace EI–K control unit.	———	———
4	Knock sensor	Visual examination, knock–sensor plug oxydation. Resistance, EI–K control–unit plug Tightening torque	12 , 13	270...330 k Ω 11...15 Nm
5	Rotational angle sensor input voltage too high	Throttle valve in idle position. Resistance, EI–K control–unit plug Resistance, EI–K control–unit plug Voltage, rotational angle sensor plug connection	21 , 22 22 , 23 22 , B– (+) (–)	3,2...4,8 k Ω 500...810 Ω 0 V
6	Rotational angle sensor input voltage too low	Ignition ON. 1.Short circuit to ground, EI–K control–unit plug and battery voltage. 2.Connect EI–K control–unit plug. Voltage, rotational angle sensor plug connection 3.Voltage, rotational angle sensor plug connection (multiply the 2nd value measured by 0.17; if nec., adjust rotational angle sensor)	22 , B+ (–) (+) 21 , 23 (+) (–) 22 , 23 (+) (–)	0 V 3,5...4,5 V
	Load signal	4.Engine at idle. Dwell angle, EI–K control–unit plug and vehicle ground. <u>Briefly</u> apply full throttle.	8 , B– (+) (–)	Dwell angle change

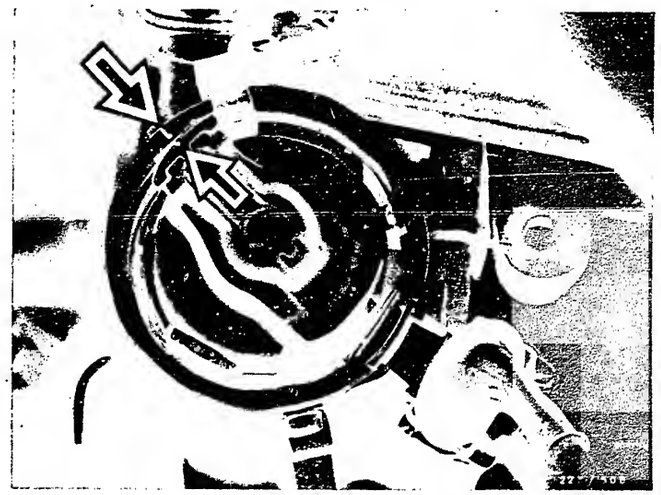
A05 — ⟹

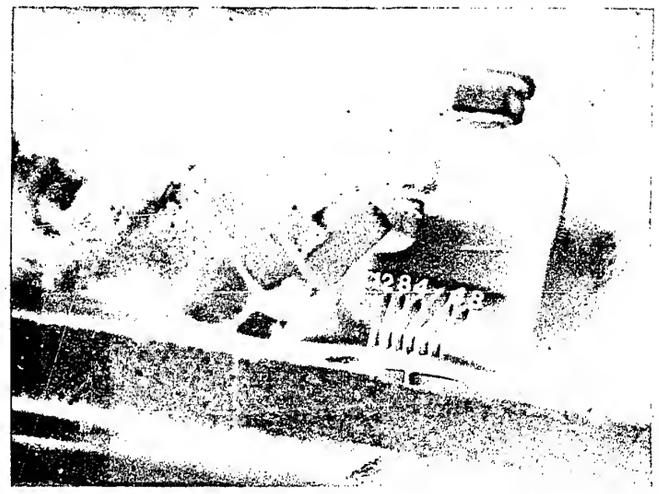
A06 — ⟸

RAPID DIAGNOSIS CHART

Primary signal and/or ignition spark available

Test step	Test of component/operation Test instructions/conditions	Term-inals	Set values
1	Visual examination, high-voltage side (ignition harness, distributor cap etc.) Ignition oscillogram		
2	Visual examination, ignition coil, plug present, sealing compound escaped? Resistance, primary Resistance, secondary	 1 , 15 1 , 4	 0,7...1,2 Ω 6,9...11,9 k Ω
3*	Ignition-distributor mounting adjustment Engine cyl. 1 at TDC. Distributor rotor center points to housing marking.		
	Check for contact resistance in voltage-supply lines to trigger box and in primary circuit.		Max. 0,3 Ω
4	Throttle-valve switch, idle contact. Run engine (norm. op. temp.) at approx. 3000 min $^{-1}$, read off ignition point. Close idle contact, read off ignition point.		Ignition point change
5	Ignition basic setting. Engine at normal operating temperature. Throttle-valve switch idle contact closed.		10° before TDC at 900...1000 min $^{-1}$



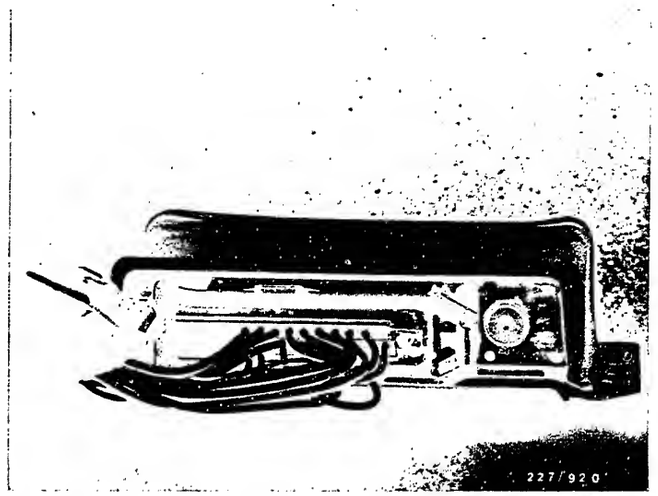


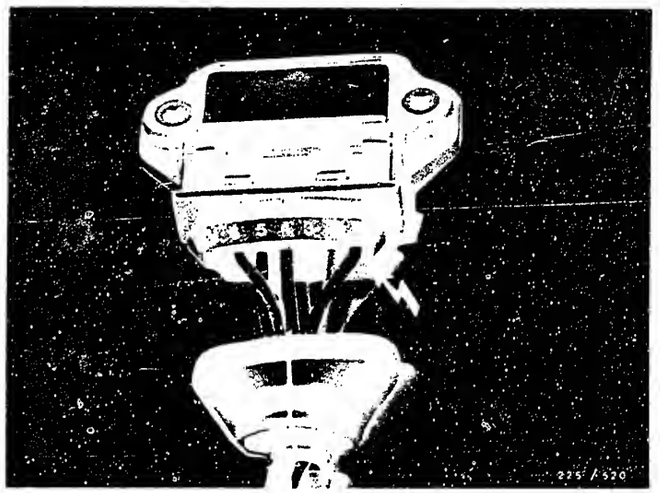
* Only perform when engine not running.

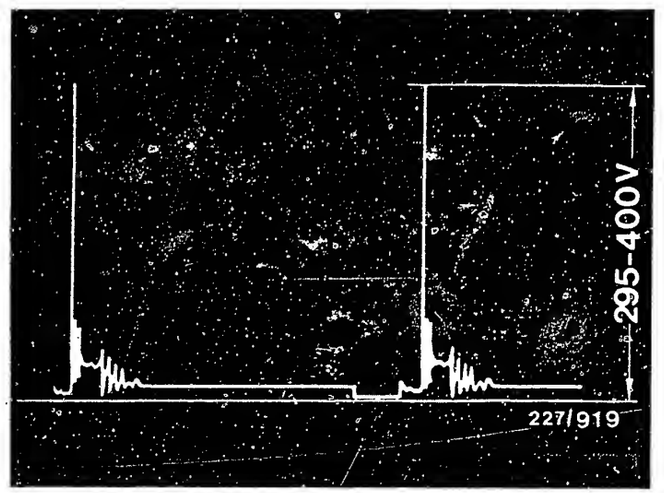
RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal and/or ignition spark available

Test step	Test of component/operation Test instructions	Terminals	Set values
6	Full-load signal Engine speed approx. 1000 min $^{-1}$ Voltage, EI-K control-unit plug Engine speed approx. 3500 min $^{-1}$ Bridge EI-K control-unit plug term. 21 and term. 22.	18 , B- (+) (-)	0...max. 1 V Approx. U_B
7	Voltage supply, trigger box Engine at idle. Voltage, trigger-box plug	4 , 2 (+) (-)	12...14 V Max. 1 V below U_B
8	Voltage supply, ignition coil Engine at idle. Voltage, ignition coild and battery	15 , B- (+) (-)	Min. 10 V
9	Engine at idle. Primary voltage, ignition coil	15 , 1 (+) (-)	295...400 V



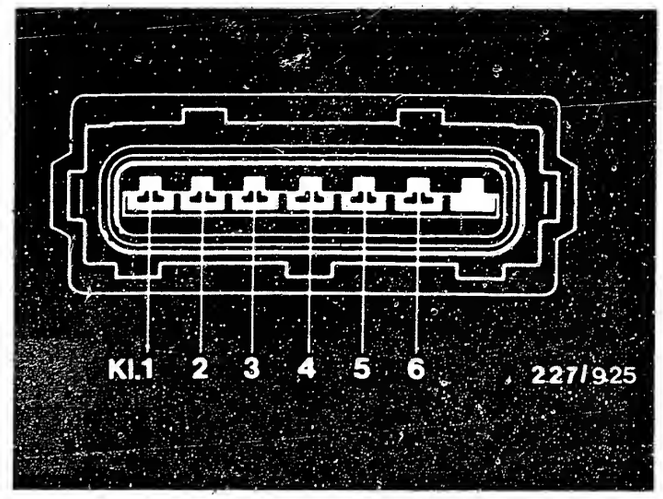


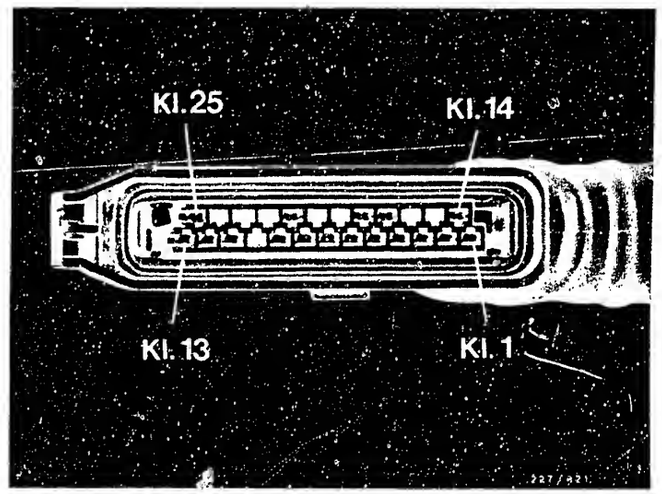


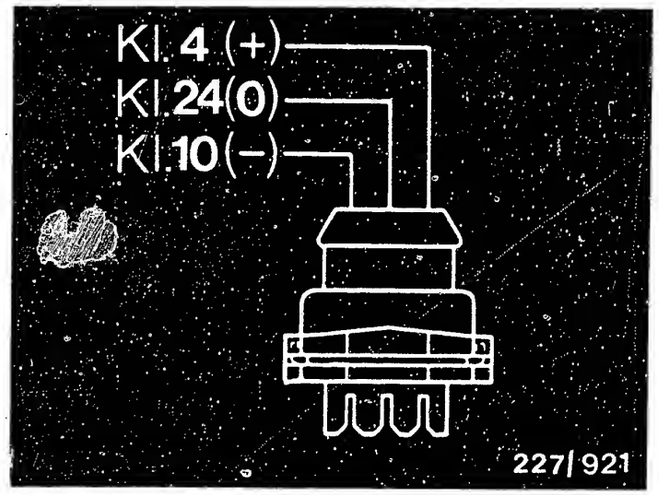
RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal and/or no ignition spark available

Test step	Test of component/operation Test instructions/conditions	Term-inals	Set values
1	Ignition ON. Voltage, trigger-box plug	4 , 2 (+) (–)	Approx. U_B
2	Ignition ON. Voltage, trigger-box plug	1 , 2 (+) (–)	Approx. U_B
3	Ignition ON. Voltage, EI-K control-unit plug	6 , 20 (+) (–)	Approx. U_B
4	Ignition-distributor plug and socket, visual examination (contacts bent, oxydation)		
5	Ignition ON. Voltage, ignition-distributor plug	4 , 10 (+) (–)	> 10 V
6	Start engine. Ignition-distributor plug test signal	24 , B- (+) (–)	Rectangular pulse
7	Start engine. Trigger-box plug test signal	5 , B- 6 , B- (+) (–)	Rectangular pulse
8	Visual examination, ignition coil, plug present, sealing compound escaped? Resistance, primary Resistance, secondary	 1 , 15 1 , 4	 0,7...1,2 Ω 6,9...11,9 k Ω





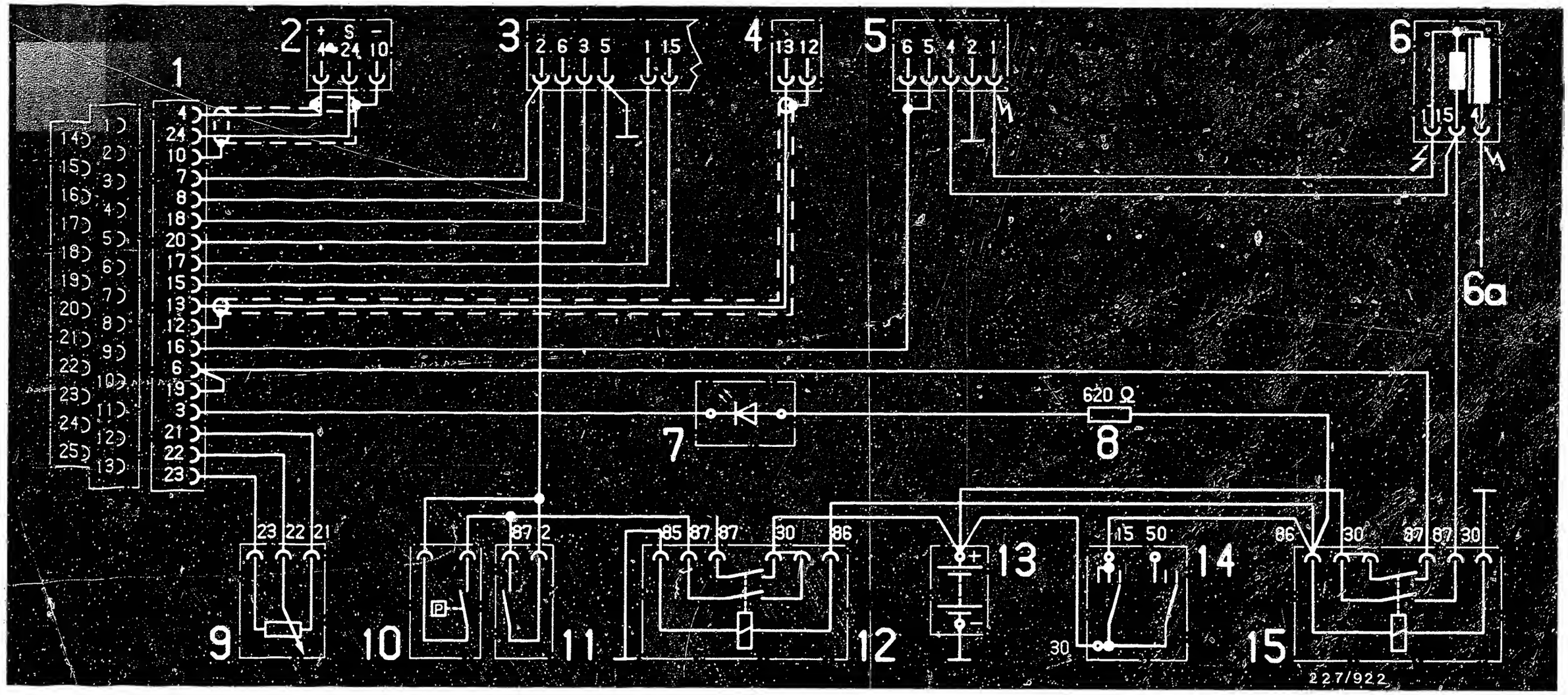


TEST SPECIFICATIONS

Ignition coil, primary	0,7...1,2 Ω
secondary	6,9...11,9 k Ω
Ignition basic setting	10° before TDC
at	900...1100 min $^{-1}$
Voltage supply EI control unit	> 10 V
Knock sensor	270...330 k Ω
Tightening torque	11...15 Nm
Rotational angle sensor	
Term. 21 and term. 23	3,2...4,8 k Ω
Term. 22 and term. 23	500...810 Ω
Voltage supply, trigger box with engine at idle	12...14 V
Voltage supply, ignition coil with engine at idle	> 10 V
Primary voltage with engine at idle	295...400 V
Voltage supply Magnetic pulse generator with ignition on	> 10 V

See Autodata test specifications for settings, for ignition, idle speed, exhaust gas, valve clearance etc.

For production reasons: continued on the following coordinate.



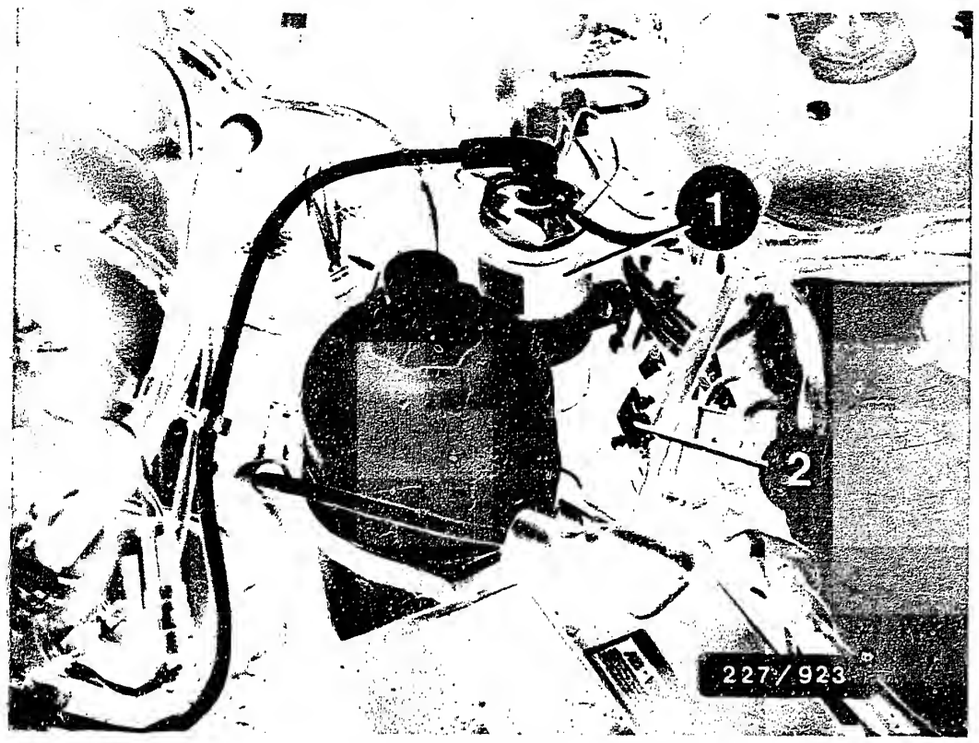
High-voltage symbols = Dangerous voltages (400 V – 25 kV)

1 = EI-K control unit
2 = Ignition distributor
3 = Jetronic control unit
4 = Knock sensor
5 = Trigger box
6 = Ignition coil
6a = To ignition distributor
7 = Indicator lamp
8 = Resistor
9 = Rotational angle sensor
10 = Charge-air pressure sensor
11 = Idle switch
12 = Auxiliary relay
13 = Battery
14 = Ignition and starting switch
15 = Supply relay

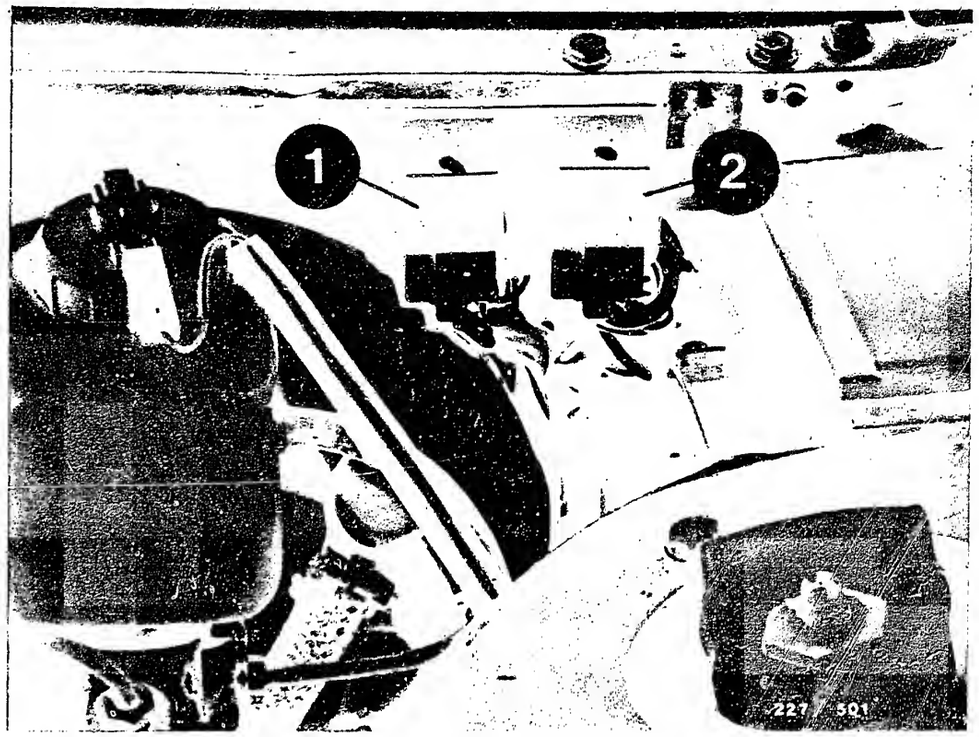
ELECTRICAL TERMINAL DIAGRAM

A15 —⟹

A16 ⟸—



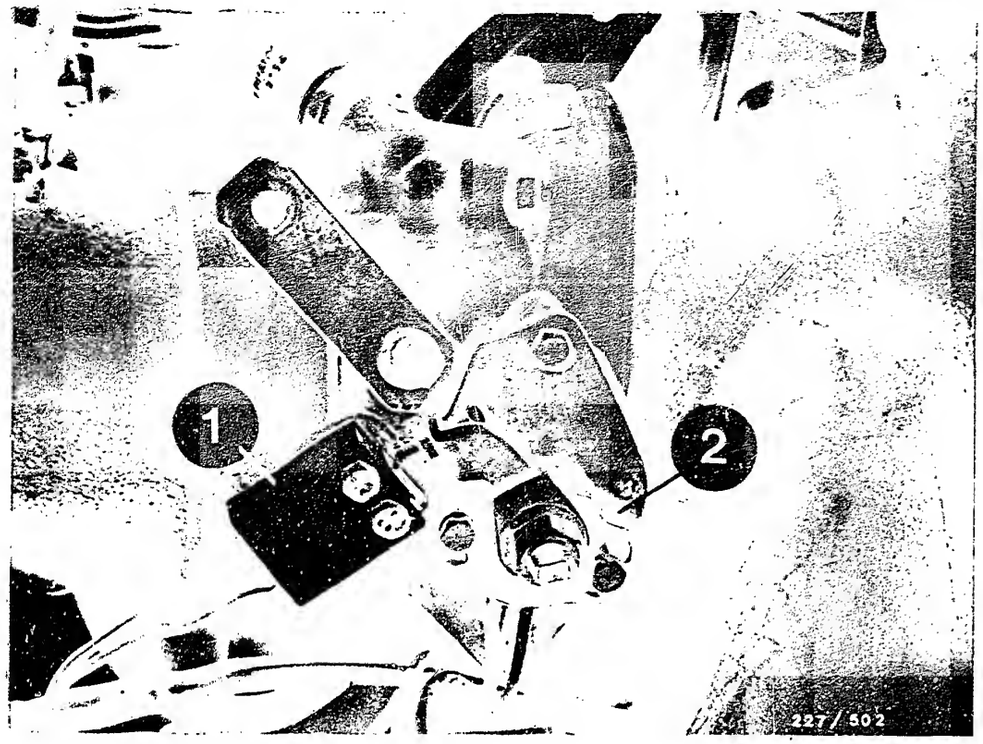
1 = Ignition coil
2 = Trigger box with heat sink



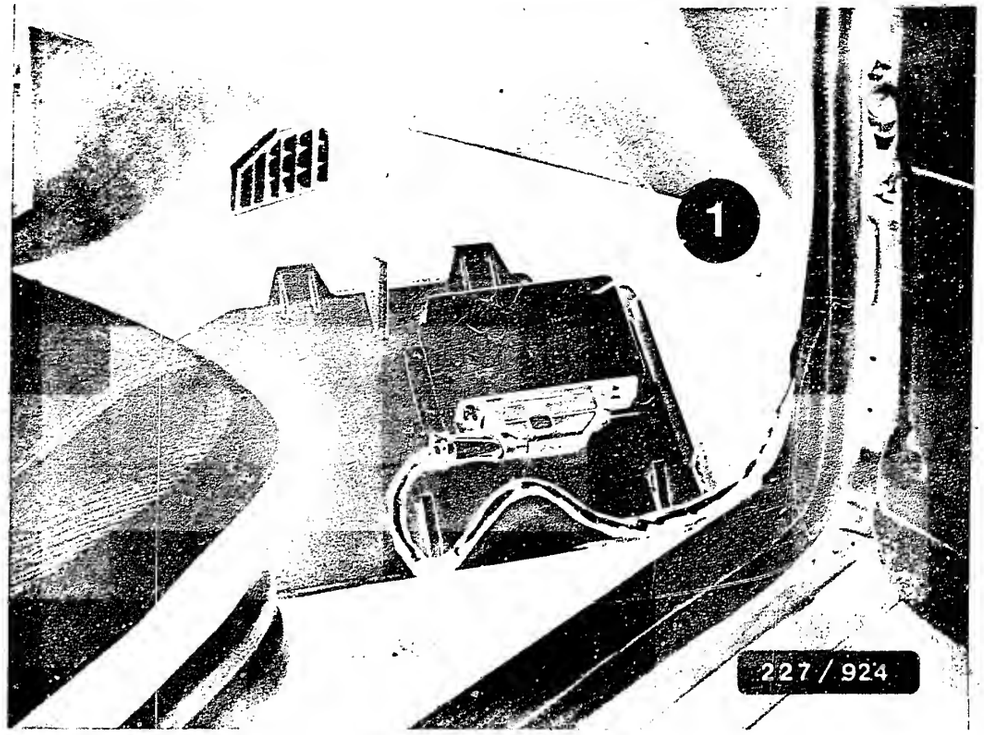
1 = Supply relay for ignition
2 = Auxiliary relay

INSTALLATION POSITION OF COMPONENTS

The trigger box and the ignition coil are mounted on a common heat sink and positioned in the engine compartment on the left (referring to forward direction of travel).



1 = Idle switch
2 = Rotational angle sensor



1 = EI-K control unit

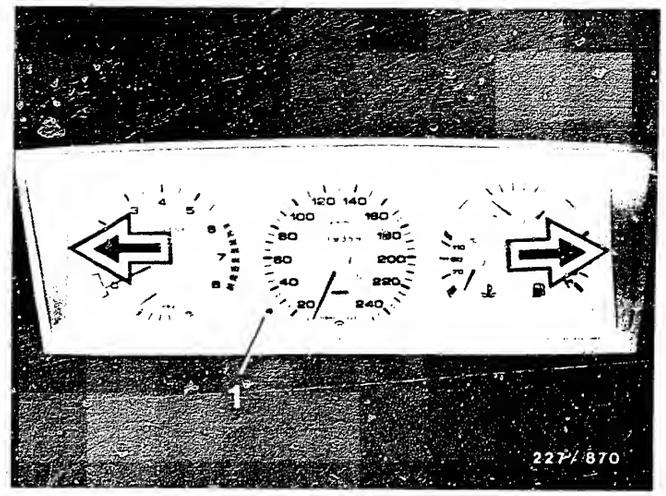
The EI-K control unit is positioned beneath the floor panel in the passenger's footwell.

Note on removal:

Loosen two fastening screws at the upper edge of the floor panel.

INSTALLATION POSITION OF COMPONENTS (continued)

Fault lamp (1) including protective resistor are positioned in the instrument panel (upper illustration).



Note on removal:

Remove steering wheel (wheels pointing straight ahead).

Insert thin screwdriver into the two bores in the instrument panel one after the other. (Upper illustration, arrows).

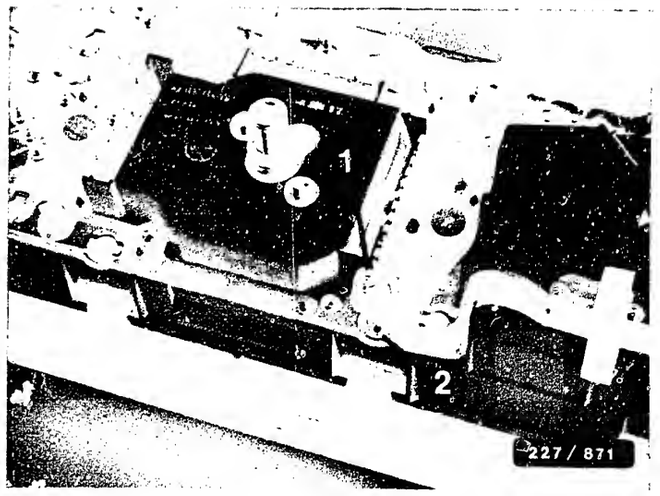
Instrument panel is unlatched by lightly pushing the screwdriver.

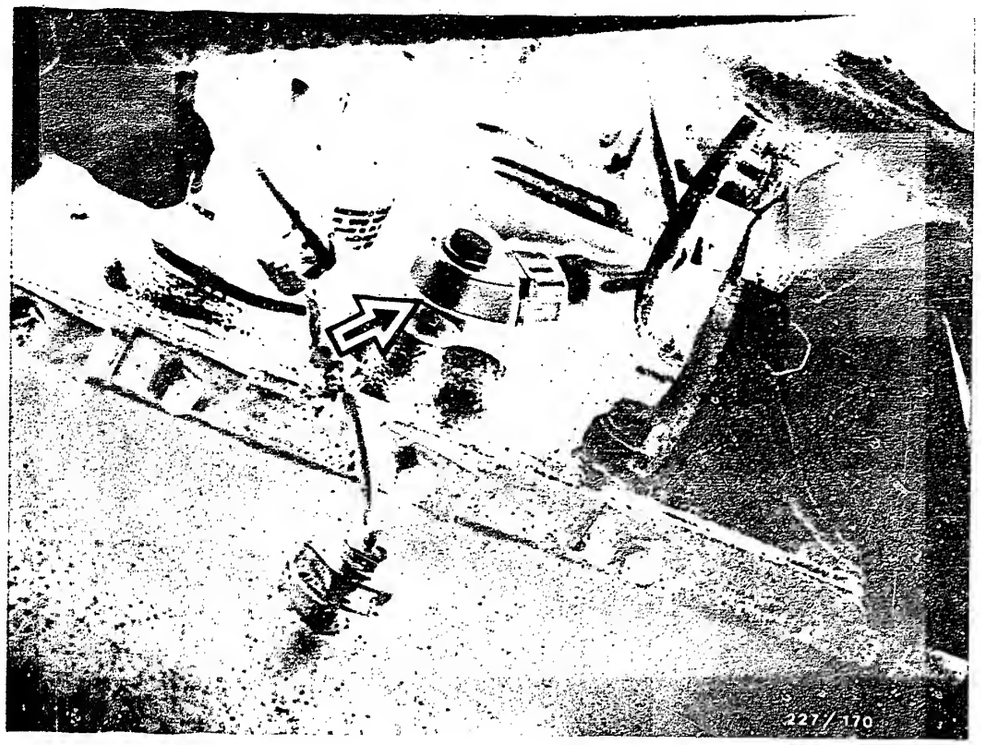
Pull instrument panel out of installation opening (speedometer shaft has latch-type connection).

Remove socket of fault lamp (1), (see lower illustration).

Installation of fault lamp:

Identified by means of a larger recess on the lower part of the printed-circuit board for feeding through the protective resistor (2) (see lower illustration).





1 = Knock sensor

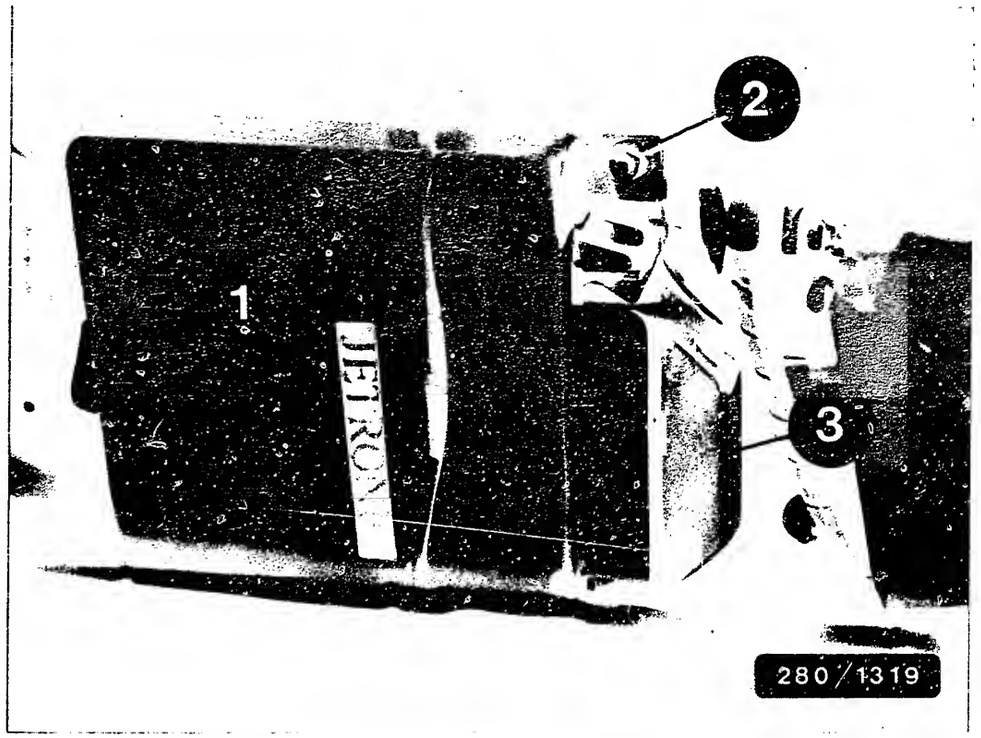
The knock sensor is positioned at the engine block (next to oil filter) on the left (referring to forward direction of travel).

Note:
Pay attention to installation position of knock sensor (horizontal connection) (see illustration).

Mount fastening screw of knock sensor w i t h o u t plain washer, spring lock washer, tooth lock washer or similar.

Tightening torque 11...15 Nm

Secure fastening screw only with locking paint.



1 = Control unit
2 = Fastening screws
3 = LU-Jetronic control-unit plug

LU-Jetronic control unit:

The control unit is positioned in the passenger compartment, passenger's side, behind the glove compartment.

To remove the control-unit plug, press the latch in the direction of the arrows.

Trouble-shooting instructions : VWW-5001

Bosch system : KE-JETRONIC

Vehicle make : VW

Basic microcard : AUD-507

Test instructions — Coordinates

SPECIAL FEATURES

These instructions contain the KE 2.5-Jetronic trouble-shooting for the following vehicle models current at the time of writing:

* VW Golf GTI 16V (EU,US,J) (04.86 ->)

* VW Scirocco GTI 16V (EU,US,J) (04.86 ->)

  1.8 l / 4-cylinder engine, 92kW/125 bhp

The KE-Jetronic of these models corresponds to the basic version, with the following additional functions and special features:

- Lambda closed-loop control
- Low-idle-speed control
- Overrun cut-off

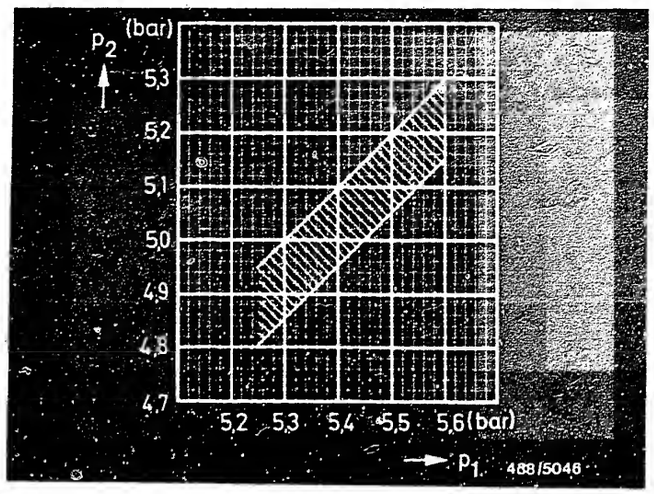
- Fuel-injection valves with fixed air-guide cap. Connection of the fuel-distributor tester with adapter sleeves KDJE-P 200/19.

- In-tank pre-supply pump

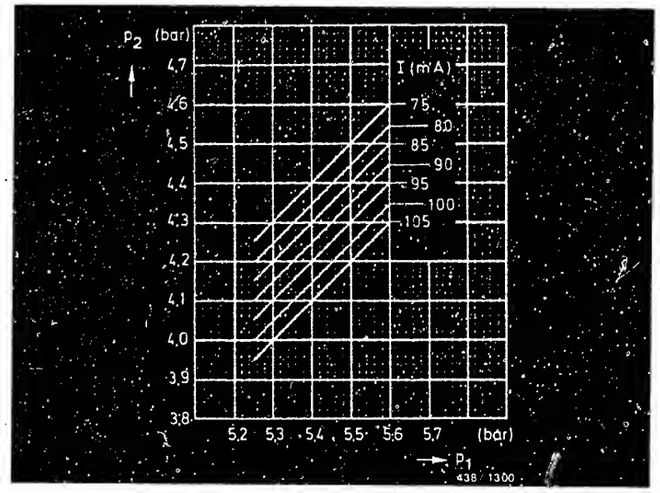
Important information:
When referring to a basic microcard, note that the test specifications must always be taken from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Test/Test condition	Test specification	
1	Electric fuel pump – delivery quantity:	min. 1100 cm^3 /min	
2	Primary pressure:	5,25...5,6 bar	
3	Differential pressure: Get lower-chamber pressure "warm" nominal value from the upper diagram corresponding to the measured primary press. (actuator current 10mA). Get the lower-chamber "cold" nominal pressure from the lower diagram corresponding to the measured primary pressure and actuator current. Tolerance ± 0.15 bar. Simulation of the "cold" state: pull the cable plug on the engine temperature sensor.		
4	Sealing test – entire system: Minimum pressure after 10 min.: Minimum pressure after 20 min.:	 2,7 bar 2,6 bar	
5	Fuel-injection valve opening pressure:	3,0...4,1 bar	
6	Delivery quantities – comparison measurement: (actuator current 0 mA)	Setting point: (cm^3 /min)	Max. allow. quantity: (cm^3 /min)
	Idle: Part load: Full load:	6,0 40,0 91,0	6,6 42,5 100,0
	Minimum quantity at max. sensor-plate deflection	91,0 cm^3 /min	



p_1 = Primary pressure
p_2 = Lower-chamber pressure



B03 — ⟹

B04 — ⟺

TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test condition	Test specifications	
7	Flow-through quantity, KE throttle:	130...150 cm ^{3} /min	
8	Engine temperature sensor (NTC):		
	Engine cold (+15...+30°C):	1,3...3,6 k Ω	
	Engine warm (approx. +80°C):	250...390 Ω	
9	Thermo-time switch - resistance measurement:	below +30°C	above +40°C
	Terminal G and ground:	25... 40 Ω	50... 80 Ω
	Terminal W and ground:	0 Ω	100...160 Ω
	Terminals G and W:	25... 40 Ω	50... 80 Ω
10	Idle-mix.-adj. screw - basic setting dimension:		
	Fuel distributor support - needle bearing:	18,7...18,9 mm	
11	Air-flow sensor potentiometer:		
	Voltage signal, sensor-plate basic setting:	0,01...0,05 V	
12	Idle adjustment*):		
	Idle speed: (regulated by low-idle-speed control)	800...900 min $^{-1}$	
	On-off ratio to be set: (bypass screw)	28...30 %	
	Exhaust-gas adj. via pressure-actuator current.		
	Test specification:	4...16 mA	
	Setting value:	9...11 mA	
	CO concentration in exhaust gas (control value):	0,3...1,2 vol.%	

*) Instructions for idle adjustment:

Exhaust-gas regulation is accomplished automatically by the lambda closed-loop control. The pressure-actuator triggering current in closed-loop operation (oscillating current reading) is tested. If the current reading is outside of the test specification, correct to the setting value by turning the idle-mixture-adjusting screw.

The CO control value is used to test whether there is any leakage in the exhaust system. Measure at the exhaust sampling pipe to the right of the intake manifold.

Switch off all electrical consuming devices as well as the air conditioner before idle testing. The radiator fan must not be running. Remove the PCV on the cylinder cover and leave open.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE2 ADAPTER CABLE 1 684 463 135 AND SUITABLE MULTIMETER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic specialist to rapidly test the electrical/electronic peripheral and control-unit functions of the KE-Jetronic, including lambda closed-loop control.

Important information concerning the following rapid diagnosis chart:

The "test conditions" column specifies the test steps during which the control-unit plug must be connected or disconnected. Great care must be taken to ensure that the system is without current during all plugging and unplugging operations, i.e. the ignition must be switched off and the electrical safety circuit must not be bridged.

The "test connections" column indicates the leads in the current path for the measurement being made, with reference to the pin assignment of the control-unit plug. Any trouble-shooting that may be required will involve these leads.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
1	| V	4	–	Pressure actuator internal resistance (R_1)	12 – 10	Disconnect control-unit plug.	20...30 Ω
2	| V	5	–	Internal resistance of engine temperature sensor	21 – 2	Control-unit plug disconnected. Engine temperature +15...+30°C: approx. +80°C:	 1.3...3.6 k Ω 250...390 Ω
3	| V	11	–	Control-unit output stage ground	20 – 2	Control-unit plug disconnected.	0...10 Ω
4	| V	9	–	Throttle-valve switch, idle	13 – 2	I m p o r t a n t : Voltage measurement; voltmeter connection: Negative = black socket "V" Positive = left blue socket " Ω " Control-unit plug disconnected. Switch on ignition. Throttle plate closed: Throttle plate open:	 8...15 V 0 V
5	| V	10	–	Throttle-valve switch, full load	5 – 2	I m p o r t a n t : Voltage measurement; voltmeter connection: Negative = black socket "V" Positive = left blue socket " Ω " Control-unit plug disconnected. Ignition switched on. Throttle plate closed: Throttle plate fully open:	 0 V 8...15 V
6	3	—	–	Air-conditioner signal (a/c readiness)	16 – 2	Control-unit plug disconnected. Switch on ignition. Switch on air conditioner:	 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
7	4	—	–	Start signal, terminal 50	24 – 2	Control-unit plug disconnected. Operate starting motor:	8...15 V
8	5	—	–	Ignition TD signal	25 – 2	Control-unit plug disconnected. Operate starting motor for a few seconds:	Voltage undefined
9	6	–	–	Control unit – supply	1 – 2	Control-unit plug disconnected. Switch on ignition.	8...15 V
10	7	–	–	Supply, air-flow sensor potentiometer	18 – 2	Connect control unit. Switch on ignition.	7...8 V
11	8	–	–	Signal, air-flow sensor potentiometer	17 – 2	Control unit connected. Switch on ignition. Sensor plate at rest: Deflect sensor plate by hand, continuous voltage rise to max. :	approx. 0 V 8 V
12	10	–	–	Idle actuator Supply and continuity, winding 1	3 – 2	Switch off ignition. Disconnect control-unit plug. Switch on ignition.	8...15 V
13	11	–	–	Idle actuator, continuity, winding 2	4 – 2	Control-unit cable plug disconnected. Switch on ignition.	8...15 V
14	12	–	–	Air-conditioner compressor signal	19 – 2	Switch off ignition. Connect control unit. Start engine and switch on air conditioner. Compressor not running: Compressor running:	0 V 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

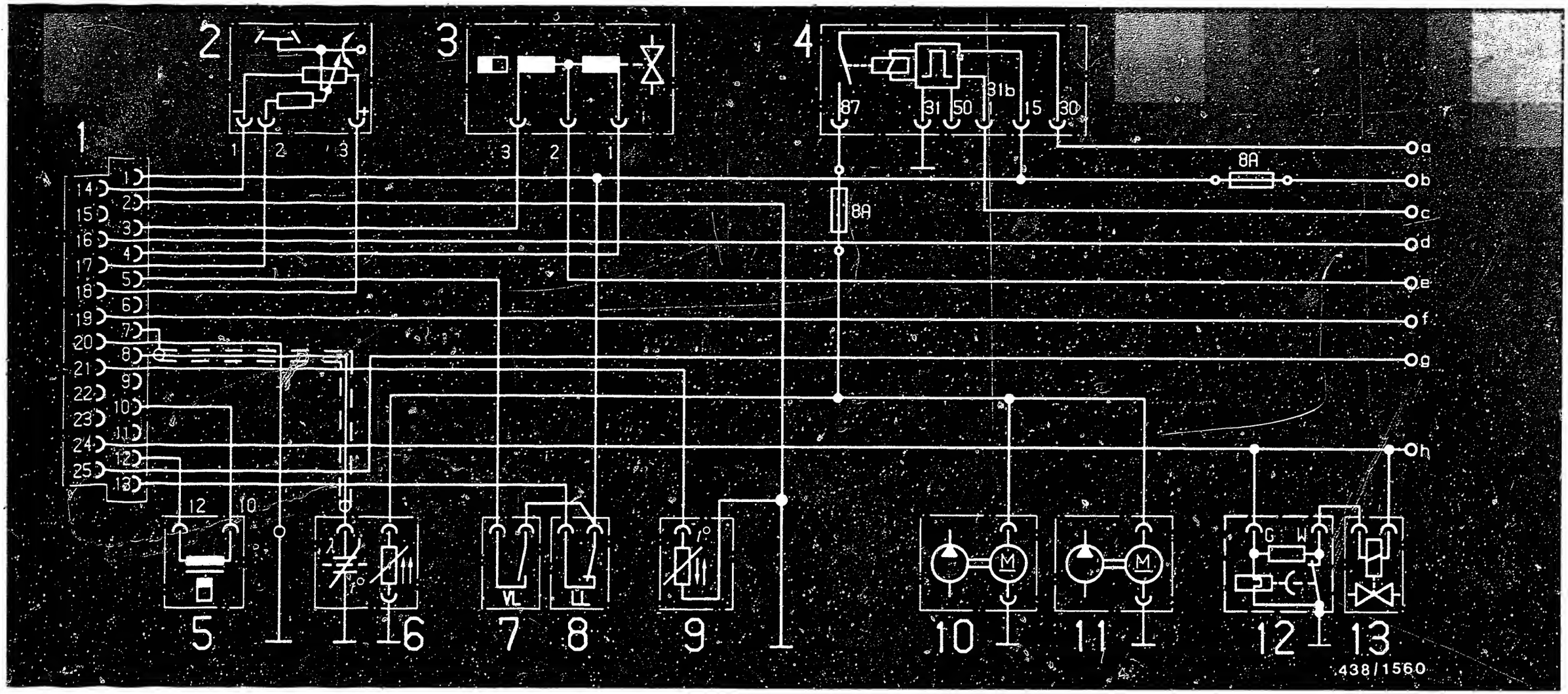
No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
15	14	24	–	Lambda closed-loop control, closed-loop operation	23 – 2	Connect control unit. Bridge sockets 1 and 2 on test adapter. Engine at normal operating temperature, idling. Closed-loop control operation: oscillating voltage reading. Mean value:	approx. 3 V
16	–	–	1	Warm-up enrichment –20°C	12 – 12	Current measurement! Tester connection: Negative = black socket 1 Positive = black socket 2 Control unit connected. Switch on ignition.	55... 75 mA
17	–	–	2	Actuator current Engine at operating temp.	12 – 12	Control unit connected. Switch on ignition.	9... 11 mA
18	–	–	1/4	Post-start enrichment	12 – 12	Control unit connected. Switch on ignition. Keep button 1 pressed: Press button 4. Voltage rise to: After short delay, regulation to: Regulation time about 90 seconds.	 55... 75 mA 120...150 mA 55... 75 mA
19	–	–	1/6	Acceleration enrichment	12 – 12	Control unit connected. Switch on ignition. Keep buttons 1 and 6 pressed. Current: Quickly deflect sensor plate. Current rise to: Regulation in about 1 second to:	 55... 75 mA 120...150 mA 55... 75 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
20	–	–	2	Overrun cut-off	12 – 12	Control unit connected. Switch around positive and negative on ammeter. Start engine. Keep engine speed n at approx.: While button 2 is pressed, actuate throttle-valve switch idle. Engine "surges". Current reading during the falling engine-speed phase:	 2500 min $^{-1}$ -40...-80 mA
21	–	–	–	Full-load enrichment	12 – 12	Control unit connected. Start engine and keep engine speed n at approx.: Actuate throttle-valve switch full load. Current increase by:	 3000 min $^{-1}$ 4....8 mA
22	–	24	–	Lambda closed-loop control closed-loop operation	12 – 12	Control unit connected. Engine at normal operating temperature in idle. Closed-loop operation can be recognized by the oscillating current reading. Mean value: If mean value outside of tolerance, set (idle-mixture-adjusting screw) to:	 4...16 mA 9...11 mA
23	–	22	–	Lambda closed-loop control rich stop	12 – 12	Control unit connected. Switch on ignition. Current rise to:	 18...22 mA
24	–	23	–	Lambda closed-loop control lean stop	12 – 12	Control unit connected. Switch on ignition. Current drop to:	 0... 2 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
25	10	–	–	Low-idle-speed control		Control unit connected. Test with lambda closed-loop control tester. Bridge black sockets 1 and 2 on test adapter. Engine idling at normal operating temperature. Idle speed (regulated): On-off ratio at idle speed: If necessary, adjust on-off ratio (bypass screw on throttle-valve assembly). Switch on air conditioner (compressor). Engine speed:	 800... 900 min $^{-1}$ 28... 30 % 900...1000 min $^{-1}$



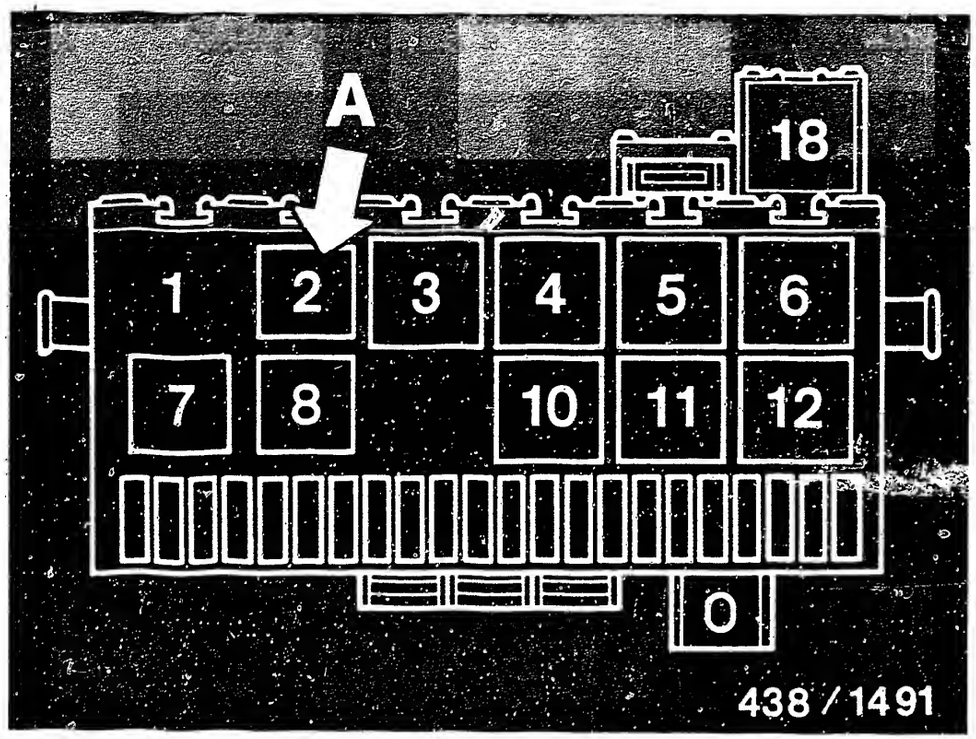
ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT

1 = KE-Jetronic control unit
2 = Air-flow sensor potentiometer
3 = Idle actuator
4 = Electronic engine-speed relay
5 = Electro-hydraulic pressure actuator
6 = Heated lambda sensor
7 = Throttle-valve switch, full load
8 = Throttle-valve switch, idle
9 = Temperature sensor, engine (NTC II)
10 = Pre-supply pump
11 = Electric fuel pump
12 = Thermo-time switch
13 = Start valve

a = Terminal 30
b = Terminal 15 (fuse 5)
c = Control unit, ignition, terminal 10
d = Air-conditioner connection (operating element)
e = Ignition coil, terminal 15
f = A/c compressor connection
g = Control unit, ignition, terminal 2 (TD signal)
h = Starting motor, term. 15a

B19 ⟹

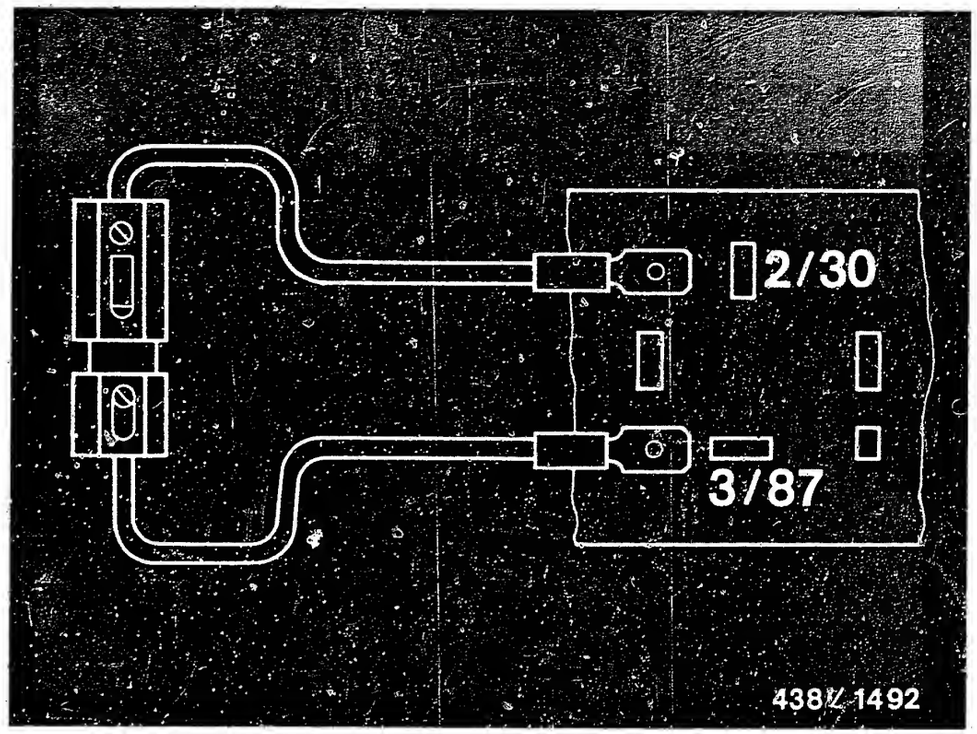
B20 ⟸



A = Fuel-pump relay

BRIDGING THE SAFETY CIRCUIT

To do this, pull the fuel-pump relay, located in the central electrics console under the switchboard on the left, out of the relay plate.



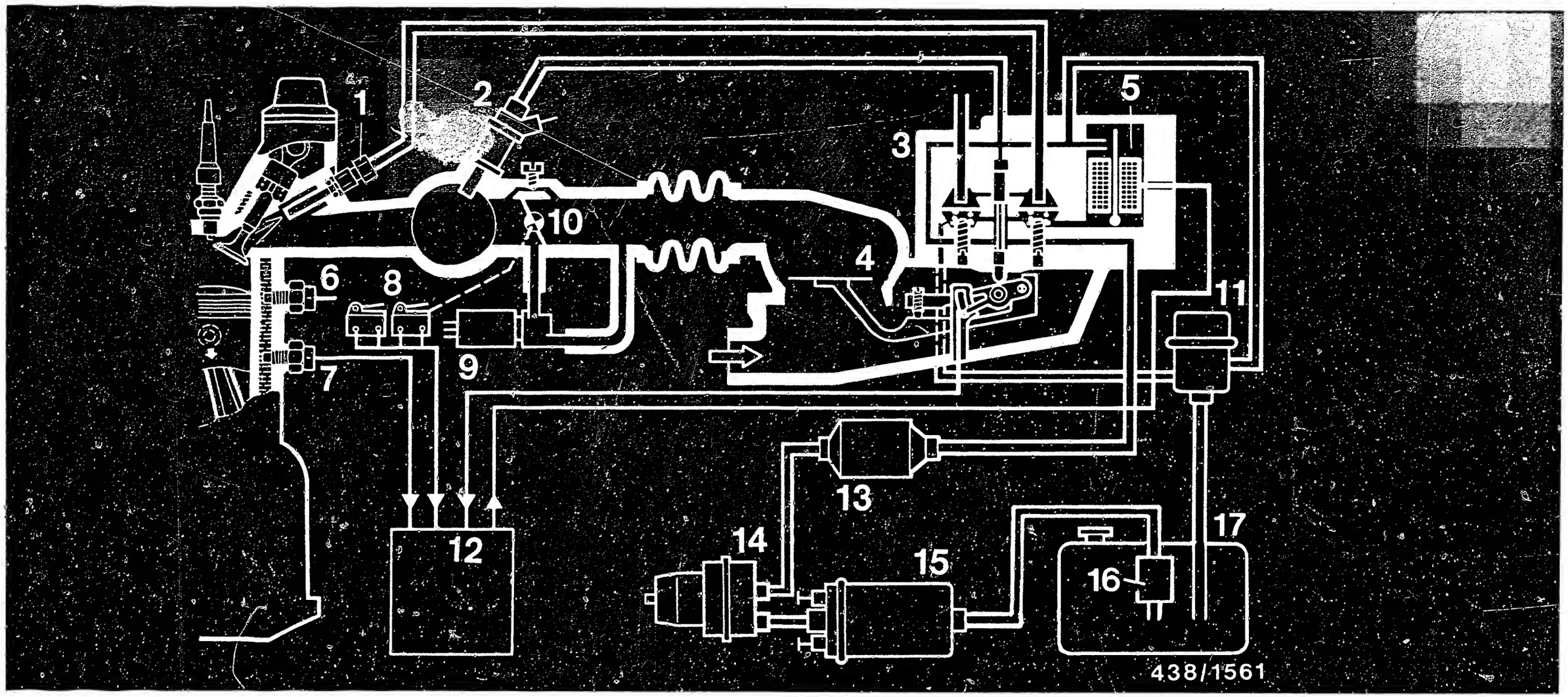
BRIDGING SAFETY CIRCUIT (CONTINUED)

Connect connections 30 and 87 with an auxiliary cable (1.5 mm ^{2} cross-section with fuse element).

I m p o r t a n t :
Operation of the electric fuel pump is required for pressure measurements. For electrical testing, switch on only the ignition.

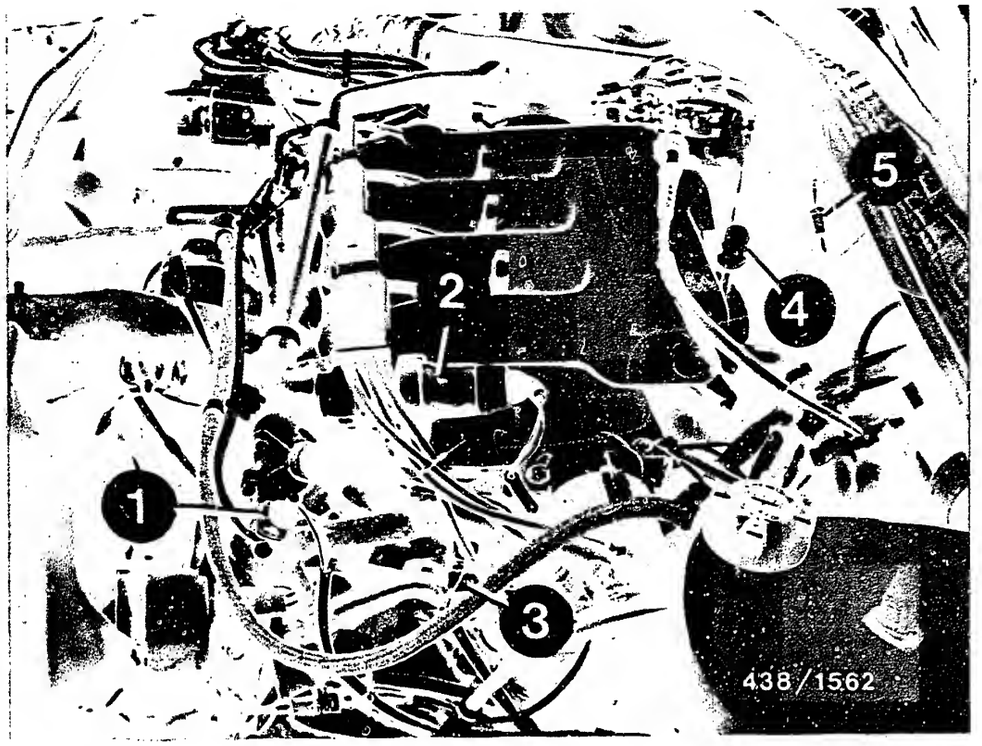
C a r e f u l :

Never deflect (lift) the sensor plate when the electric fuel pump is running, as this would cause fuel to be injected. Subsequent operation of the starting motor could lead to extremely serious engine damage.



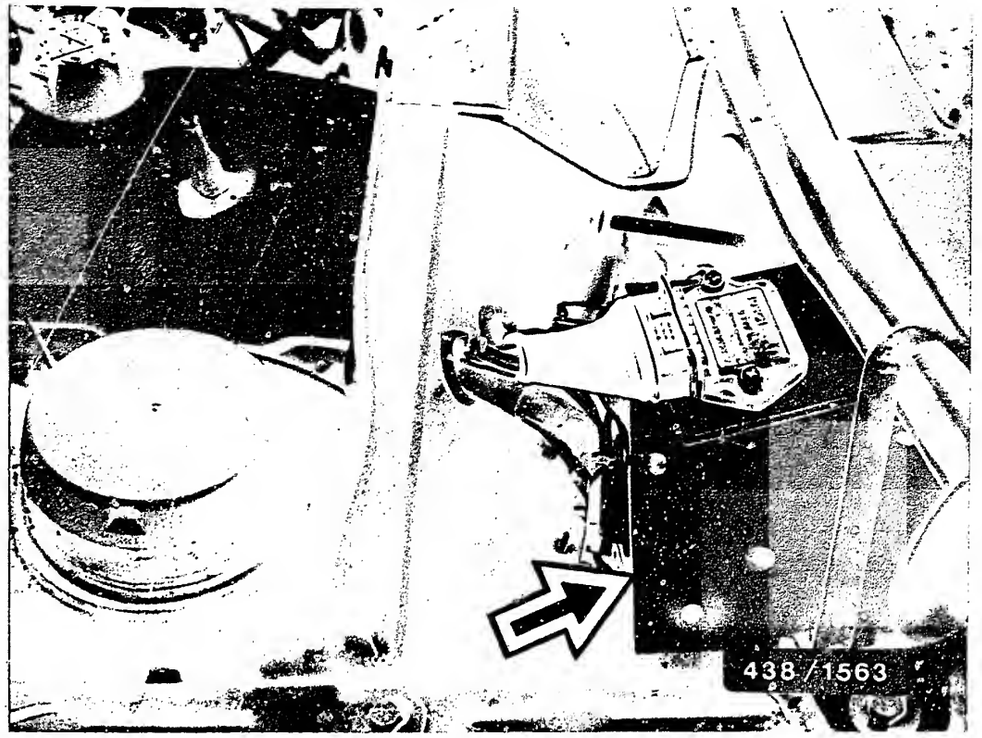
AIR- AND FUEL-LINE DIAGRAM

1 = Fuel-injection valve
2 = Start valve
3 = Fuel distributor
4 = Air-flow sensor
5 = Electro-hydraulic pressure actuator
6 = Thermo-time switch
7 = Temperature sensor (NTC)
8 = Throttle-valve switch I/FL
9 = Idle actuator
10 = Throttle valve
11 = Pressure regulator (primary pressure)
12 = KE-Jetronic control unit
13 = Fuel filter
14 = Fuel accumulator
15 = Electric fuel pump
16 = Pre-supply pump
17 = Fuel tank



1 = Start valve
2 = Idle actuator
3 = Thermo-time switch
4 = Exhaust-sampling pipe
5 = Lambda-sensor plug connection

INSTALLATION POSITION O- COMPONENTS



Arrow = KE-Jetronic control unit
(beneath a covering)

INSTALLATION POSITION OF COMPONENTS (CONT.)

* Lambda-sensor:
  In catalytic converter, on bottom of vehicle.

* Electric fuel pump, fuel accumulator:
  In the rear-axle area.

* In-tank free-supply pump

TABLE OF CONTENTS

Trouble-shooting instructions : AUD-512

BOSCH system : ABS

Vehicle make : AUDI

Basic microcard : AUD-501

SPECIAL FEATURES

This microcard is for ABS testing with ABS tester ETT 016.00 (0 684 101 600) for the following vehicles:

Audi quattro, 80 quattro, 90 quattro, Coupé quattro, 100 quattro, 200 quattro as of start of production. 85 model year included.

The ABS in the Audi quattro contains 4 wheel-speed sensors and a 3-channel hydraulic modulator for front/rear split brake circuits.

The vehicles have central and rear-axle differential locks which are selectable by means of a 2-stage push-pull switch. The ABS is switched off automatically on selecting either of the locks. The driver can decide to drive either with ABS or with differential lock. By means of the push-pull switch, intake-manifold pressure is applied to a pneumatic actuator which allows the lock in the differential to take effect through an actuating lever. When the lock has been engaged, an electrical switch on the differential is mechanically actuated and switches off the power supply to the ABS.

Apart from the ABS indicator lamp, the indicator lamp for the corresponding differential lock also lights up.

RAPID DIAGNOSIS CHART FOR ABS TESTER

The following rapid diagnosis chart makes it possible for the experienced ABS expert to quickly check the ABS with the ABS tester.

If detailed instructions and information are required, use the similar detailed testing instructions SIS/AUD-501.

Before testing with the ABS tester, make sure that the following requirements are met.

REQUIREMENTS FOR TESTING WITH ABS TESTER

* The tester must have been converted to the latest technical status (identification "U2" on nameplate or as of FD 352).

* Check ground connection of return pump and of overvoltage-protection relay or relay set term. 31 for security and corrosion.

* Check hydraulic connections and joints on hydraulic modulator for leaks (visual examination).

* If, while driving, the ABS warning lamp comes on occasionally (e.g. after switching on electrical devices) and goes out again by itself, check battery and power supply (alternator, regulator and voltage drops).

* If the ABS warning lamp is constantly on and does not go out, check the following:

  - Multiple plug correctly seated on controller and latched?
    All contacts O.K.?
    Spring contacts latched?
  - V-belt broken? (Alternator not supplying any power, charge indicator lamp and ABS warning lamp on).
  - Alternator term. 61 supplying power?
    Plug-in connection and lead to ABS controller O.K.?
  - Perform loose-contact test on wheel-speed sensors with program switch in position 10.

* For testing with the tester, switch on ignition for all program-switch positions (tester operates on power supply from vehicle battery).

* Watch tester lamps 1 and 2 in all program-switch positions.

C a u t i o n !

Do not drive with tester connected.

Repeat the entire test program after each repair.

General note on trouble-shooting:

Check all leads for short circuit to ground and contact with positive leads, and watch for wearing and pinching.

* Connect ABS tester to controller and ABS wiring harness.

C a u t i o n !

Disconnect and connect controller only with ignition off.

On the Audi 80 Quattro, Audi Quattro up to 7.84, the controller is installed in the luggage compartment, rear right, behind a cover.
On all Quattro vehicles as of 8.84 it is installed under the rear seat bench on the left.

RAPID DIAGNOSIS CHART FOR ABS TESTER ETT 016.00 (0 684 101 600)

Differential locks must be off in order to maintain ABS power supply.

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
1...24	Power supply for each test step	1 (+) and 10 (–)	Switch on ignition	Lamp 1 (green) must be lit for each test step	* Battery unsufficiently charged. Repeat test step with engine running. * High voltage drops across terminals (e.g. ground terminal). * ABS switch–off relay, ABS step–by–step relay, overvoltage–protection relay or ABS relay set defective. * Open circuit in ground connection.
1	Valve relay – off–position	32 and 10	Switch on ignition	Lamp 1 (green) and lamp 3 (green) must be lit	* Open circuit or high contact resistance in leads to valve relay. * Valve relay defective.
2	Valve relay – operation	32 and 10 Negative to 27	Switch on ignition	Lamp 1 (green) and lamp 3 (green) must be lit	
3	Motor relay – off–position	14 and 10	Switch on ignition	Lamp 1 (green) and lamp 3 (green) must be lit	* Open circuit or high contact resistance in leads to motor relay. * Motor relay defective. * Check pump motor for continuity.
4	Motor relay – operation	14 and 10 Negative to 28	Switch on ignition Press illuminated key	Lamp 1 (green) and lamp 3 (green) must be lit	

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
5	Fuse and uni-directional-breakdown diode in over-voltage-protection relay or relay set (under test is the relay which is plugged into the test plug on the tester).	1 and 10	Ignition off. Disconnect controller. Plug relay from vehicle into test plug on back of tester using adapter lead. Plug new relay into vehicle. Switch on ignition; wait approx 1 sec., then press illuminated key. After testing, switch off ignition and re-connect controller.	Lamp 1 (green) must be constantly lit. After pressing illuminated key, lamp 3 (green) must light up.	* The relay in the socket on the tester is defective.
6	Internal resistances of solenoid-op. valves in hydraulic modulator	2 and 32 35 and 32 18 and 32	Ignition on. Press key FL Press key FR Press key RA	Lamp 1 (green) must be constantly lit FL: 0,7...1,7 Ω FR: 0,7...1,7 Ω RA: 0,7...1,7 Ω	* Open circuit or high contact resistance in leads to respective valve * Hydraulic modulator defective.
7	Ground connection to terminal 10	10	Ignition on. Press illuminated key.	Lamp 1 (green) must be constantly lit 80...300 m V	* Open circuit or high contact resistance in ground lead and ground terminal.
8	Ground connection to terminal 34	34	Ignition on. Press illuminated key.	Lamp 1 (green) must be constantly lit 30...250 m V	
9	Ground connection to terminal 20	20	Ignition on. Press illuminated key.	Lamp 1 (green) must be constantly lit. 30...250 m V	

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
10	Internal resistances of wheel-speed sensors		Ignition on.	Lamp 1(green) must be constantly lit	* Check for loose contacts: Move all leads at fastening points, at plug and at wheel-speed sensor and watch reading. * Open circuit or high contact resistance in leads to the respective wheel-speed sensor. * Respective wheel-speed sensor defective.
		4 and 22	Press key FL	0,8...1,8 k Ω	
		21 and 23	Press key FR	0,8...1,8 k Ω	
		7 and 9	Press key RL	0,8...1,8 k Ω	
		24 and 26	Press key RR	0,8...1,8 k Ω	
11	Insulation resistances of wheel-speed sensors		Ignition on.	Lamp 1 (green) must be constantly lit	* Check leads to respective wheel-speed sensor for insulation damage. * Respective wheel-speed sensor defective.
		22 and 10	Press key FL	20...999 k Ω	
		23 and 10	Press key FR	20...999 k Ω	
		9 and 10	Press key RL	20...999 k Ω	
		26 und 10	Press key RR	20...999 k Ω	
12	DC voltage on wheel-speed sensor leads		Ignition on	Lamp 1 (green) must be constantly lit	* Check leads to respective-wheel sensor for contact (worn spot) with a positive lead. * Respective wheel-speed sensor defective.
		22 and 10	Press key FL	000...100 m V	
		23 and 10	Press key FR	000...100 m V	
		9 and 10	Press key RL	000...100 m V	
		26 and 10	Press key RR	000...100 m V	
13	Controller-internal supply voltage	12 and 10	Ignition on. Press illuminated key:	Lamp 1 (green) must be constantly lit. 4,75...5,25 V	* Controller defective.
14	Diode (in hydraulic modulator) in forward direction and ABS warning lamp	29 and 32	Ignition on.	0,4...1,5 V ABS warning lamp in vehicle must light up.	* Open circuit or high contact resistance in leads to diode/indicator lamp. * Indicator lamp defective. * Diode (hydraulic modulator) defective.

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
15	Diode (in hydraulic modulator) in reverse direction	29 and 32 Negative to 29	Ignition on	2,5...8,5 V ABS warning lamp slightly dimmer	* Diode (hydraulic modulator) defective.
16	Controller, BITE (built-in test equipment) triggering	29 and B +	Ignition on. Press illuminated key for min. 3 sec.:	ABS warning lamp must go out after max. 1 sec.	* Controller defective.
17	Controller, BITE fault simulation	29 and B +	Ignition on. Press illuminated key for min. 3 sec.:	ABS warning lamp must be constantly lit (flickering after approx 1 sec. allowable).	* Controller defective.
18	Not applicable				
19	Controller, current for pressure reduction	2 35 18	Ignition on. Press key FL. Press illuminated key: Press key FR Press illuminated key: Press key RA Press illuminated key:	 FL : 4,5...6,0 A FR : 4,5...6,0 A RA : 4,5...6,0 A	* Controller defective.
24	Voltage from stop-lamp switch	25 and 10	Ignition on. Press brake pedal.	10...15 V	* Lead to stop-lamp switch defective. * Stop-lamp switch defective. * Stop lampms defective.

A dynamic brake analyzer is required for program-switch positions 20, 21, 22 and 23.
Do not drive with tester connected.
Do not use a brake-pedal actuating device for setting the braking force.
Program-switch position 23 must come first.
Front axle: Drive front wheels of vehicle onto dynamic brake analyzer.
Pull on handbrake.

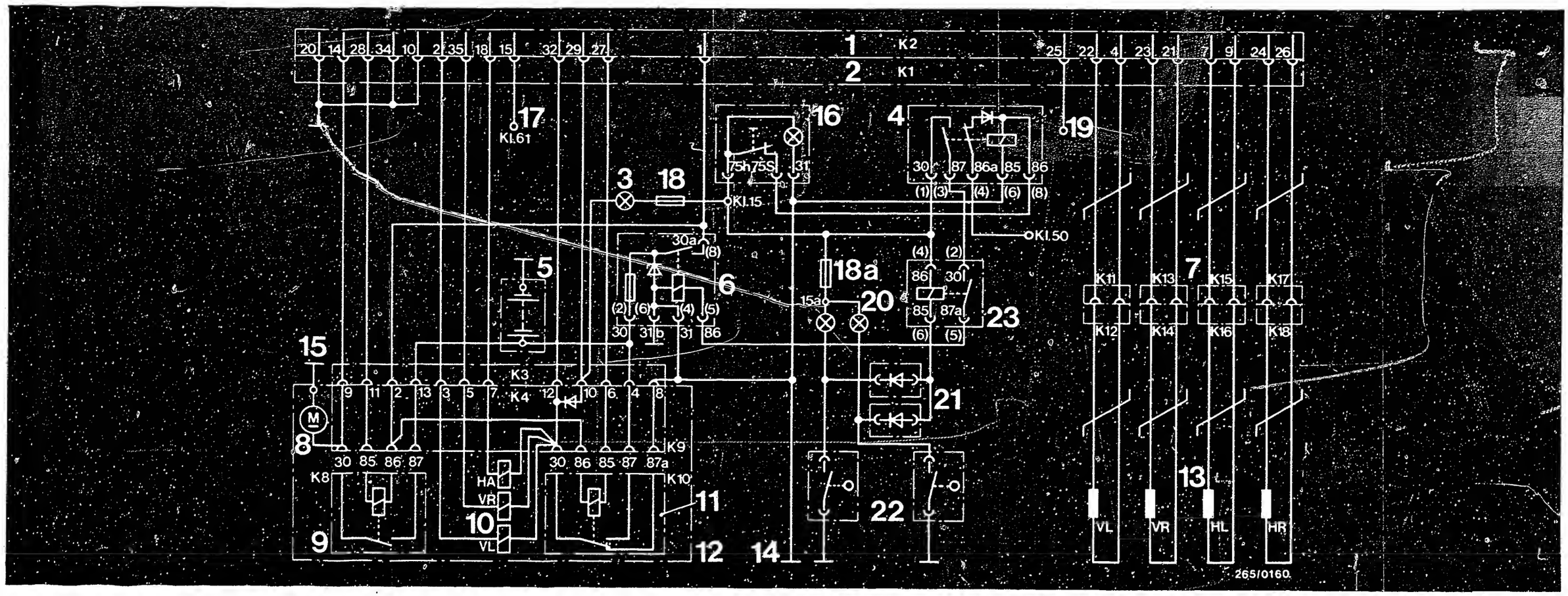
Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
23	Wheel-speed sensor signal. Identity check	22 and 4	Press key FL. Switch on left-hand brake roller.	FL : 1,7...19	* Wheel-speed sensors mixed up? * Air gap too big. * Respective wheel-speed sensor defective.
		23 and 21	Press key FR. Switch off left-hand brake roller; switch on right-hand brake roller.	FR : 1,7...19	
20	Hydraulic modulator Pressure reduction Identity check	Current supply to term. 35	Press key FR Switch on right-hand brake roller. Press brake pedal and hold constant at 2000 N. Press illuminated key.	FR: < 1100 N	* Brake lines mixed up? * Conventional braking system O.K.? * Hydraulic modulator defective. N o t e: Replace hydraulic modulator as a complete unit only. Repair not allowed. D a n g e r !
		Current supply to term. 2	Press key FL. Switch off right-hand brake roller. Switch on left-hand brake roller. Hold constant at 2000 N with brake pedal. Press illuminated key.	FL: < 1100 N	
21	Hydraulic modulator Pressure build-up	Current supply to term. 2	Press key FL. Switch on both brake rollers, press brake pedal and hold constant at 2000 N. Press illuminated key.	Left-hand reading on dynamic brake analyzer moves to an intermediate value and rises again to FL: 600...1500 N	

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
21	Hydraulic modulator Pressure build-up	Current supply to term. 35	Press key FR. Switch on both brake rollers. Press brake pedal and hold constant at 2000 N. Press illuminated key.	Right-hand reading on dynamic brake analyzer moves to an intermediate value and rises again to FR : 600...1500 N	* Brake lines mixed up? * Conventional braking system O.K.? * Hydraulic modulator defective. N o t e : Replace hydraulic modulator as a complete unit only. Repair not allowed. D a n g e r !
22	Hydraulic modulator Pump delivery brake circuit 1	Current supply to term. 35	Switch on brake rollers. Read off right-hand inherent-friction value. Press key FR. Press brake pedal and hold constant at 2000 N. Press illuminated key.	After an intermediate reading on right, return pump cuts in briefly. Right-hand reading must drop below inherent-friction value plus 200 N Reading appears only briefly.	* Hydraulic modulator defective. N o t e : Replace hydraulic modulator as a complete unit only. Repair not allowed. D a n g e r !

Rear axle: Drive wheels of vehicle onto dynamic brake analyzer.
Release handbrake.

Program switch position	Testing of	Measure at controller terminals	Additional operation	Test specifications (Reading)	Cause of trouble
23	Wheel-speed sensor signal and identity check	7 and 9	Press key RL. Switch on left-hand brake roller.	RL: 1,7...19	* Wheel-speed sensors mixed up? * Air gap too big. * Respective wheel-speed sensor defective.
		24 and 26	Press key RR. Switch off left-hand brake roller. Switch on right-hand brake roller.	RR: 1,7...19	
20	Hydraulic modulator Pressure reduction	Current supply to term. 18	Press key RA. Switch on both brake rollers. Press brake pedal and hold constant at 1500 N. Press illuminated key.	RA: <900 N	* Brake lines mixed up? * Conventional braking system O.K.? * Hydraulic modulator defective. N o t e : Replace hydraulic modulator as a complete unit only. Repair not allowed. D a n g e r !
21	Hydraulic modulator Pressure build-up	Current supply to term. 18	Press key RA. Switch on both brake rollers. Press brake pedal and hold constant at 1500 N. Press illuminated key.	Readings on both sides of dynamic brake analyzer move to intermediate values and rise again to RA: 400...1000 N	
22	Hydraulic modulator Pump delivery brake circuit 2	Current supply to term. 18	Switch on brake rollers. Read off inherent-friction value. Press key RA. Press brake pedal and hold constant at 1500 N.	After an intermediate reading on both sides, return pump cuts in briefly. Readings on both sides must drop below inherent-friction value plus 200 N Reading appears only briefly.	* Hydraulic modulator defective. N o t e : Replace hydraulic modulator as a complete unit only. Repair not allowed. D a n g e r !

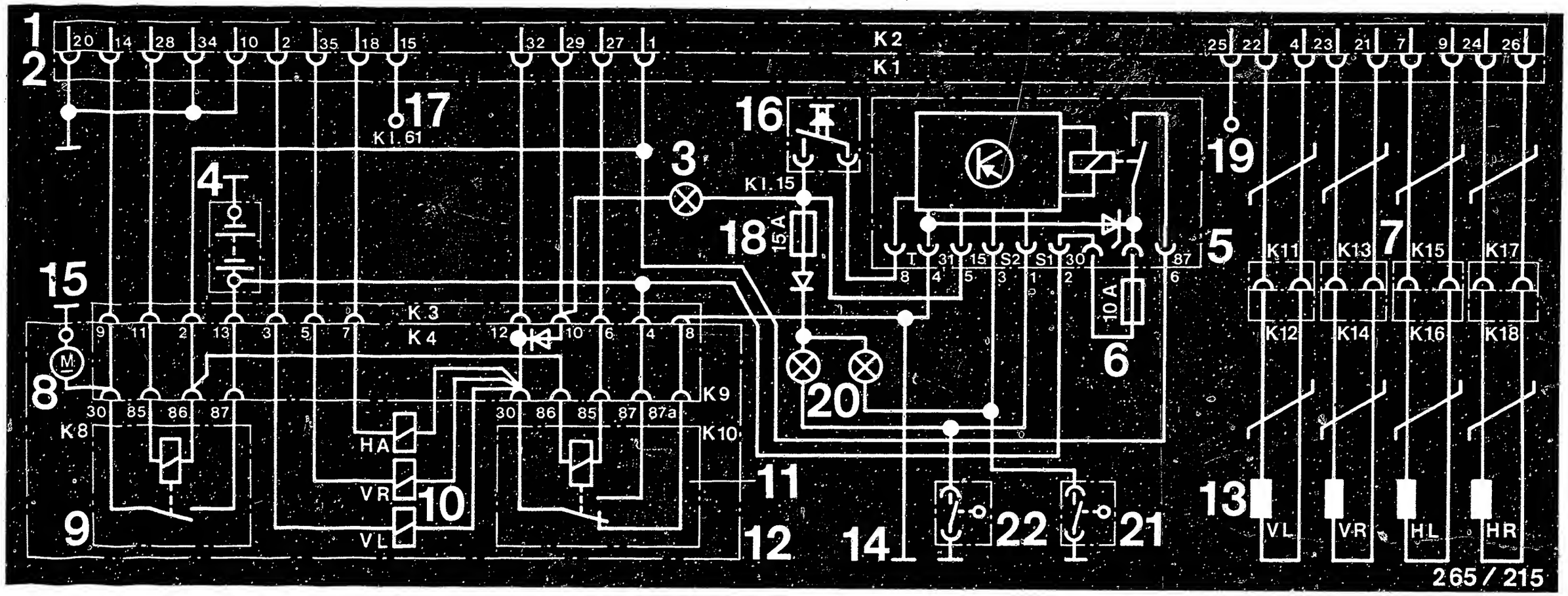
Finally, perform a road test. With the engine running, warning lamp must go out. Drive at at least 30 km/h. Warning lamp must not come on again.



1 = Electronic controller
2 = Multiple plug (35-pin)
3 = ABS warning lamp
4 = Relay for controller (step-by-step relay)
5 = Battery
6 = Overvoltage-protection relay
7 = Cable connector
8 = Return-pump motor
9 = Motor relay
10 = Solenoid-operated valves
11 = Valve relay
12 = Hydraulic modulator
13 = Wheel-speed sensor
14 = Ground terminal behind dashboard
15 = Ground terminal, eng. comp. left
16 = ABS switch
17 = to alternator
18 = Fuse in relay board with fuse holder
18a = Fuse No. 12 (15A) in central-electrics box
19 = to stop-lamp switch
20 = Indicator lamps for differential locks
21 = Diode plug
22 = Switch for differential locks
23 = ABS switch-off relay

VL = FL = front left
VR = FR = front right
HL = RL = rear left
HR = RR = rear right
HA = RA = rear axle
K1, K2
etc. = Plug numbers

ABS ELECTRICAL TERMINAL DIAGRAM up to 7/84 date of manufacture



1 = Electronic controller
2 = Multiple plug (35-pin)
3 = ABS warning lamp
4 = Battery
5 = Relay set
6 = Plug-in fuse (10A) in relay set
7 = Cable connector
8 = Return-pump motor
9 = Motor relay
10 = Solenoid-operated valves
11 = Valve relay
12 = Hydraulic modulator
13 = Wheel-speed sensor
14 = Ground terminal behind dashboard
15 = Ground terminal, eng. comp. left
16 = ABS switch
17 = to alternator
18 = Fuse No. 12 (15 A) in central-electrics box
19 = to stop-lamp switch
20 = Indicator lamps for differential lock
21 = Switch for differential lock (rear)
22 = Switch for differential lock (central)

VL = FL = front left
VR = FR = front right
HL = RL = rear right
HR = RR = rear right
HA = RA = rear axle
K1, K2
etc. = Plug numbers

ABS ELECTRICAL TERMINAL DIAGRAM as of 8/84 date of manufacture

C21 — <==> C22 — <==

TEST EQUIPMENT AND TOOLS

Description	Designation	Part Number
ABS tester Use only converted testers. Identification "U2" on nameplate or as of FD 352	ETT 016.00	0 684 101 600
Adapter cable for connection of overvoltage-protection relay or relay set		1 684 460 120
Dynamic brake analyzer	e.g. BPS 100 or BPS 101 or BPS 104 or BPS 105	0 680 012 .. 0 680 013 .. 0 680 018 .. 0 680 019 ..
Charging and bleeding device		e.g. ATE part number 3.9302-1000.4 1)
Bleeder fitting For connecting the charging and bleeding device to the master-cylinder brake-fluid reservoir		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 1)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal actuating device		ATE Part No. 3.9312.0100.4 1)

1) Obtainable from: Alfred Teves GmbH, Guerickestr. 7, D-6000 Frankfurt (Main).

Test equipment and tools (continued)

Description	Designation	Part Number
Pressure tester Tester for low- and high-pressure testing of hydraulic braking systems		e.g. ATE Part No. 3.9305-0200.4 1)
Double-end box wrench, open 9 x 11 mm		Hazet Part No. 612 2)
Vessel for catching the brake fluid approx 1 l		
Brake fluid Use only ATE genuine brake fluid DOT4 of VW brake fluid.		
Electrics tester or multimeter for trouble-shooting	ETE 014.00	0 684 101 400 commercially available
Grease for wheel-speed sensors		Molykote Longterm 2
Protective caps for brake lines		1 900 508 002 (100 pieces)
Protective caps for brake-line connections on hydraulic modulator		1 900 508 004 (100 pieces)
Use only genuine VW brake lines.		

1) Obtainble from:
Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

2) Obtainable from: Hazet D-5630 Remscheid

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" apply always as viewed in the forward direction of travel.

* ABS indicator lamp:
  In instrument panel.

* ABS switch:
  In instrument panel.

* Front-axle wheel-speeed sensors:
  One each on left and right in steering knuckles.

* Rear-axle wheel-speed sensors:
  One each on left and right near the brake calipers.

* Hydraulic modulator:
  In engine compartment on left in front of brake master cylinder.

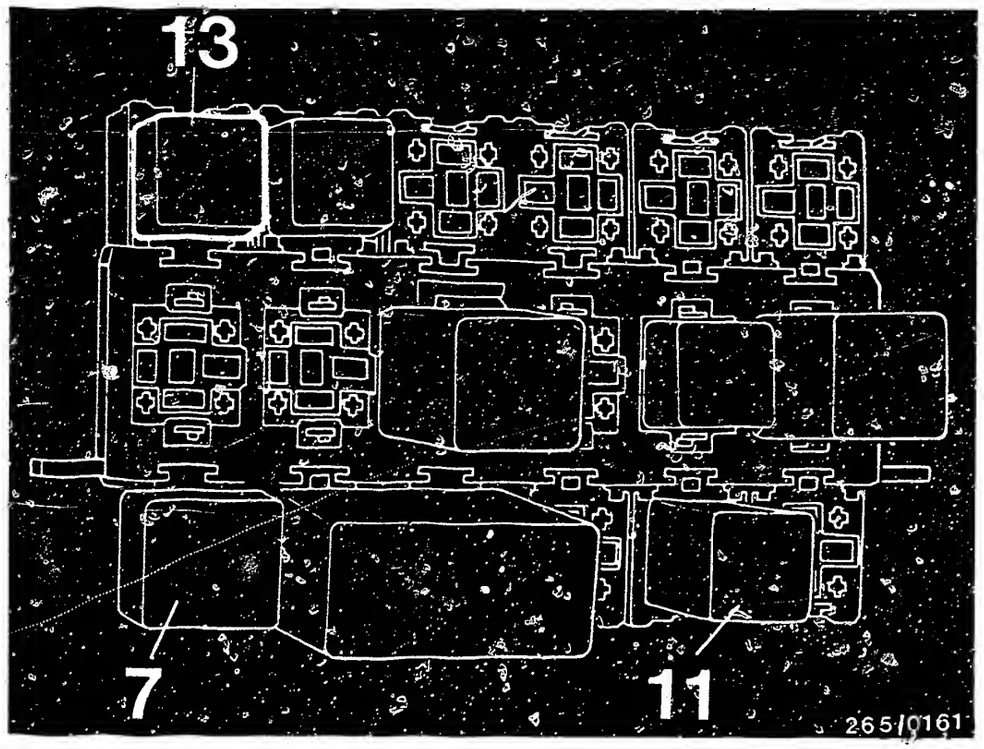
* Ground terminal for ABS:
  On hydraulic modulator mounting.

* Controller:
  Audi 80 Quattro, Audi Quattro up to 7.84:
  In luggage compartment, rear right, behind a cover.
  All Quattro vehicles as of 8.84:
  Under rear seat bench on left.

* Switches for differential locks:
  One each in housings for central and rear-axle differential locks.

* Diode plug:
  Under instrument panel, near relay support.
  Not applicable if relay set installed.

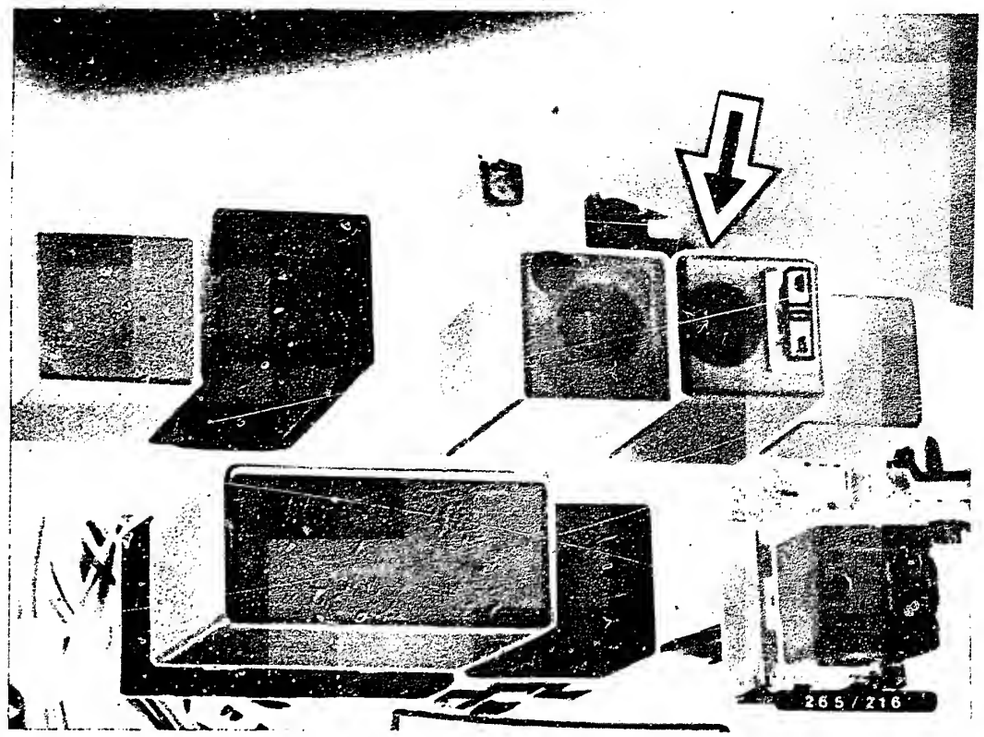
For production reasons:
continued on the following coordinate.



* Relay for controller (step-by-step relay) up to 7.84:
  Under instrument panel on left in relay support, relay location 7.

* Overvoltage-protection relay up to 7.84:
  Under instrument panel on left in relay support, relay location 11.

* ABS switch-off relay for differential lock up to 7.84:
  Under instrument panel on left in relay support, relay location 13.



* Relay set as of 8.84:

  Under the instrument panel on the right in the relay support (see picture, arrow).

T A B L E O F C O N T E N T S

Trouble-shooting instructions	: BMW-518
BOSCH System	: Computer-aided transmission shift
Vehicle make	: BMW
Basic microcard	: BMW-00/E121

Special features

This microcard contains the testing instructions for the electronic transmission control in BMW models 535i, 635CSi, 735i as of 10.84, 325i and 525e as of 9.1985.
The transmission control has an independent control unit, but is linked to the Motronic through various inputs and outputs.
For testing with the universal test adapter, it is necessary to use the special adapter lead 1 684 463 161 (GS1).
If no fault is found in the transmission control, continue trouble-shooting with the Motronic (with SIS BMW 516).

1. Rapid diagnosis chart for universal test adapter

The following rapid diagnosis chart makes it possible for the expert to quickly check the electrical part of the system with the univeral test adapter. Even if a fault occurs, still go through all test steps one after the other.

The rapid diagnosis chart contains the following information:

* Switch positions on universal test adapter
* Sequence of test steps
* Notes on how to operate the universal test adapter or other components.
* Readings on multimeter and motortester
* The Trouble-shooting column in some cases refers to defective components which are tested in later test steps.

If detailed instructions and information are necessary, use similar microcard SIS-BMW-00/E121.

Rapid diagnosis chart for universal test adapter with adapter lead 1 684 463 161

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
1	V	1	Selector switch in position "P". Ignition off. Disconnect transmission control unit and pump relay. Measure insulation resistance of RPM sensor shielding. Term. 23 to term. 5 (ground).	> 100 k Ω	* RPM sensor * Lead (or shielding)
2	V	2	Measure insulation resistance of RPM sensor. Term. 8 to term. 5.	> 100 k Ω	
3	V	3	Measure insulation resistance between shielding and RPM sensor lead. Term. 23 to term. 27.	> 100 k Ω	
4	V	4	Measure winding resistance of RPM sensor. Term. 8 to term. 27	0.7 ... 1.8 k Ω	
5	V	5	Measure shunt resistance of kick-down switch. Do not press accelerator Term. 2 to term. 5.	> 100 k Ω	* Kick-down switch
6	V	6	Measure insulation resistance of solenoid-operated valves and of pressure regulator in transmission. Term. 1 to term.5.	> 100 k Ω	* Leads * Solenoid-op. valves (in transmission) * Pressure regulator (in transmission)
7	V	7	Not applicable		
8	V	8	Program switch of vehicle in position "S". Measure insulation resistance of program switch. Term. 14 to term. 5.	> 100 k Ω	* Program switch
9	V	9	Check connection between term. 10 and term. 6.	635 CSi: < 10 Ω 535i + 735i: infinity Ω	* Establish/take apart corresponding connection.
10	V	10	Check connection between term. 26 and term. 6.	535i: < 10 Ω 635CSi + 735i: infinity Ω	

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
11/12	| V	11/12	Not applicable		
13	| V	13	Check warning lamp for electronic transmission control. Measure resistance between term. 33 and term. 5.	10 ... 150 Ω	* Warning lamp for transmission control * Gear indicator plug connector
14	| V	14	Press accelerator as far as it will go. Measure resistance of kick-down switch. Term. 2 to term. 5.	< 10 Ω	* Kick-down switch * Plug connector
15	| V	15	Measure resistance of ground leads between term. 19 and term. 5	< 10 Ω	* Ground leads * Contact resistances
16	| V	16	Measure winding resistance of solenoid-operatated valve MV1 (in transmission). Term. 16 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Solenoid-op. valve 1
17	| V	17	Measure winding resistance of solenoid-operated valve MV2 (in transmission). Term. 17 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Solenoid-op. valve 2
18	| V	18	Measure winding resistance of solenoid-operated valve for reverse-gear lock (in transmission). Term. 20 to term. 21.	25 ... 65 Ω	* Transmission plug connector * Reverse-gear lock solenoid-op. valve
19	| V	19	Measure winding resistance of solenoid-operated valve for converter clutch (in transmission). Term. 25 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Converter clutch solenoid-op. valve
20	| V	20	Measure winding resistance of pressure regulator (in transmission). Term. 22 to term. 1	4.5 ... 9 Ω	* Transmission plug connector * Pressure regulator
21	| V	21	Not applicable		

D05 — <⟹>

D06 — <⟹>

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
22	3	22	Voltage measurement. Ω switch position "22"; V switch position " 3". Selector switch in position "P". Pull on handbrake. Measure supply voltage for transmission control. Term. 35 to term. 5.	10 ... 15 V	* Main relay (term. 87) * Plug connector to Motronic (13-pin) * Corresponding leads
23	4	22	Selector switch in position 1. Measure voltage. Term. 18 to term. 5.	> 6 V	* Selector switch * Corresponding plug connectors and leads
24	4	22	Selector switch in position 2. Measure voltage.. Term. 18 to term. 5.	< 1 V	
25	5	22	Selector switch in position 2. Measure voltage. Term. 28 to term. 5.	> 6 V	
26	5	22	Selector switch in position 3. Measure voltage. Term. 28 to term. 5.	< 1 V	
27	6	22	Selector switch in position 3. Measure voltage. Term. 29 to term. 5.	> 6 V	
28	6	22	Selector switch in position D. Measure voltage. Term. 29 to term. 5.	< 1 V	
29	7	22	Selector switch in position D. Measure voltage. Term. 30 to term. 5.	> 6 V	
30	7	22	Selector switch in position N. Measure voltage. Term. 30 to term. 5.	< 1 V	
31	8	22	Selector switch in position N. Measure voltage. Term. 4 to term. 5.	> 6 V	
32	8	22	Selector switch in position R. Measure voltage. Term. 4 to term. 5.	< 1 V	

Rapid diagnosis chart for universal test adapter (continued)

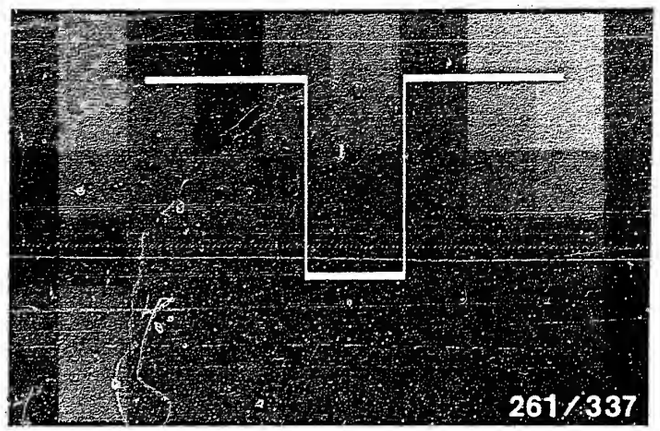
Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
33	8	22	Selector switch in position P. Measure voltage. Term. 4 to term. 5.	< 1 V	* Selector switch
34	9	22	Switch off ignition. Connect sockets 1 and 2 with a lead or with ammeter (1.5A). Selector switch in position P. Connect control unit. Switch on ignition. Set program switch to position E. Measure voltage (term. 15 to term. 5). Follow sequence of operations!	> 4 V	* Program switch
35	9	22	As test step 34, but program switch position 3–2–1	< 0,8 V	
36	10	22	As test step 35, but measure term. 14 to term. 5.	< 1 V	
37	10	22	As test step 36, but program switch position E	< 0,5 V	
38	11	22	Briefly operate starting motor; then do not switch off ignition and do not press accelerator. Measure term. 31 to term. 5. Pump relay disconnected.	> 2 V	* Plug connector to Motronic (13–pin) * Throttle–valve sensor * Control unit
			As above, but with wide–open throttle.	< 1 V	
39/40	12/13	22	Not applicable		
41	14	22	Check power supply to throttle–valve sensor. Measure term. 9 to term. 5.	> 4 V	* Control unit
42	15	22	Measure voltage at tap of throttle–valve sensor – term. 7 to term. 5 – with accelerator in rest position.	< 1 V	* Throttle–valve sensor and adjustment * Plug connector to Motronic (13–pin)
			As above, but with wide–open throttle.	> 4 V	
43.1	16	22	Connect pump relay. Let engine run and set program switch to "S". Warning lamp for transmission control comes on until self–test has been successfully completed.	After self–test, warning lamp for transmission control goes out	* ti–/TD signal absent * Torque–reduction lead, term. 24 Motronic control unit term. 10 * Control unit * Solenoid–operated valves

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
43.2	16	22	Selector switch in position "N". Engine idling. Measure voltage. Term. 20 to term. 5.	10...15 V	* Control unit (reverse-gear lock output)
44	17	22	As test step 43.2 but term. 16 to term. 5.	< 1 V	* Control unit (solenoid -op. valve 1 output)
45	18	22	As test step 43.2 but term. 17 to term. 5.	< 1 V	* Control unit (solenoid -op. valve 2 output)
46	19	22	As test step 43.2 but term. 25 to term. 5.	10...15 V	* Control unit (converter clutch output)
47	16	22	Drive vehicle onto chassis dynamometer. Program switch in position "S", selector switch at "D". Slowly bring speed to approx. 20 km/h Term. 20 to term. 5.	< 1 V at approx. 20 km/h	* Control unit (reverse-gear lock output) * No RPM sensor signal (test steps 58, 59)
48	17	22	As test step 47, but vehicle speed approx. 50 km/h. Term. 16 to term. 5.	10...15 V at approx. 50 km/h	* Control unit (solenoid -op. valve 1 output) * No RPM sensor signal
49	18	22	As test step 47, but vehicle speed approx. 90 km/h. Term. 17 to term. 5.	10...15 V at approx. 90 km/h	* Control unit (solenoid -op. valve 2 output) * No RPM sensor signal

Rapid diagnosis chart for universal test adapter (continued)

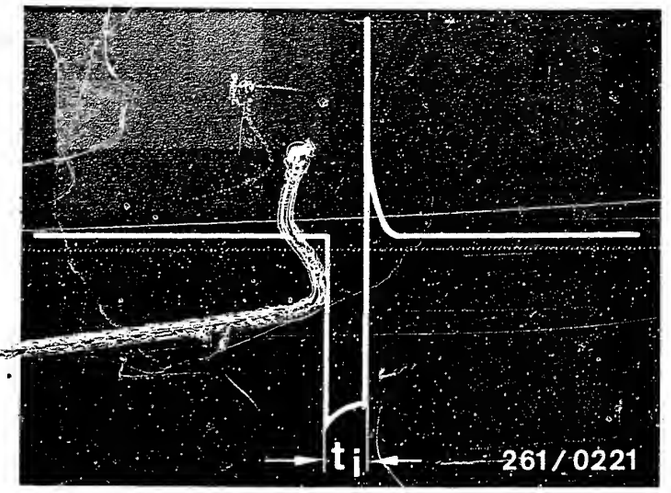
Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
50	19	22	After test step 49, foot off accelerator, switch ignition off briefly and then on again. Slowly raise speed to approx. 110 km/h. Otherwise as test step 47. Term. 25 to term. 5.	< 1 V at approx. 110 km/h	* Control unit (converter clutch output) * No RPM sensor signal
51	20	22	Not applicable		
52	20	22	Vehicle on chassis dynamometer. Engine idling. Selector switch at "D". Measure current at sockets 1 and 2 on universal test adapter (current measurement in lead 22). Warning: Do not cause a short circuit to ground!	900... 1000mA	* Control unit (pressure regulator output)
53	20	22	As test step 52, but briefly accelerate engine	Reading decreases	
54	21	22	Vehicle on chassis dynamometer. Program switch in position "1-2-3". Selector switch at "1". Raise engine speed to above 1500 min^{-1}. Shift selector switch to position "2" etc. Observe signal term. 24 to term. 5 on oscilloscope.	Approx. 1 sec. after gear shift 1 to 2 negative pulses (see top picture)	* Connection between transmission control unit term. 24 and Motronic control unit term. 10 through 13-pin plug * Transmission control unit (torque-reduction output) * Motronic control unit (input of map switch term. 10)

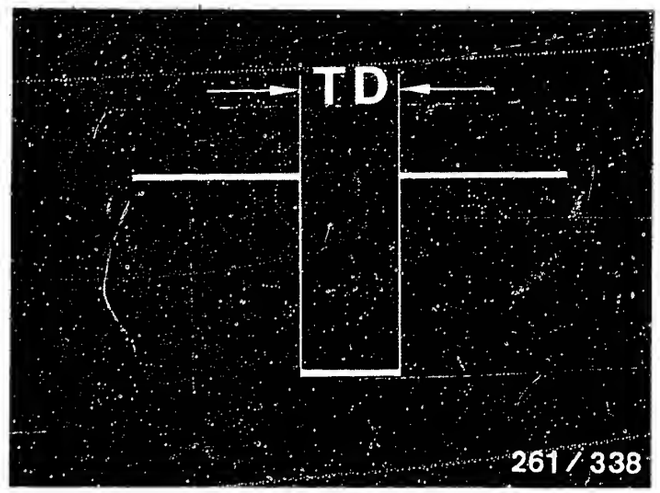


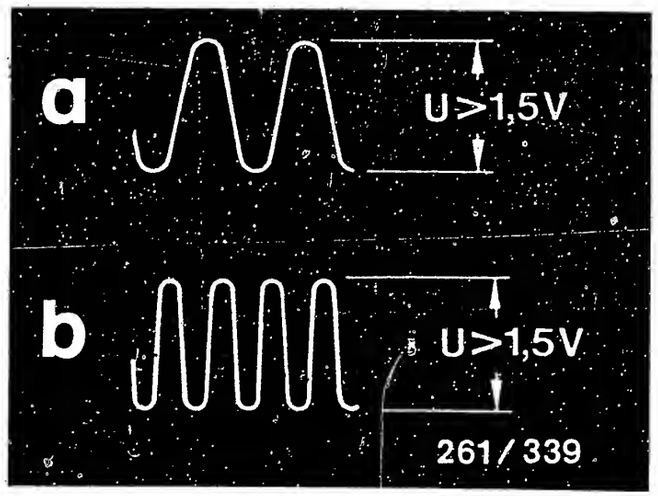
Torque-reduction signal

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
55	21	22	Not applicable		
56	22	22	Vehicle on chassis dynamometer. Program switch in position "S". Selector switch in position "D". Engine idling. Connect oscilloscope to test wells. Measure t_i signal. Term. 11 to term. 5.	See top picture for signal.	* Plug connector to Motronic (13-pin) * Motronic control unit
57	23	22	As test step 56, but measure TD signal. Term. 21 to term. 5.	See center picture for signal.	
58	2	22	As test step 56, but vehicle speed approx. 10 km/h. Measure RPM sensor signal. Term. 8 to term. 5.	See bottom picture (a) for signal	* Transmission plug connector * RPM sensor in transmission (incorrectly adjusted)
59	2	22	As test step 58, but vehicle speed approx. 20 km/h. Signal frequency and voltage amplitude increase.	See bottom picture (b) for signal	





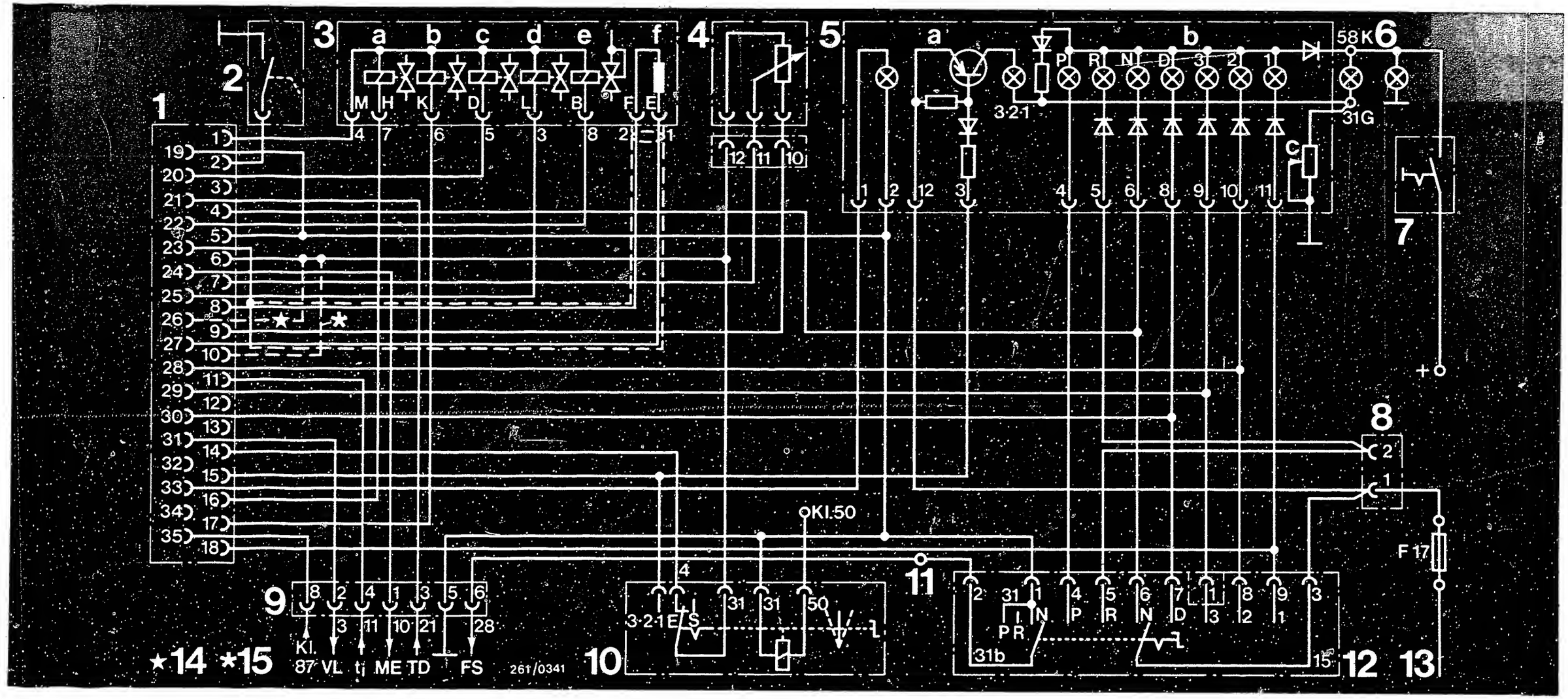


2. Test specifications

The stated test specifications apply to measurements directly on the component or on the 35-pin plug without test adapter connected.

RPM sensor (in transmission):	0.7 ... 1.8 k Ω
Press. regulator (in transmission):	1.7 ... 4.5 Ω
Solenoid-op. valves (in transmission) MV1 and MV2, reverse-gear lock and converter clutch, each:	22 ... 60 Ω
Kick-down switch actuated:	0 Ω
Selector switch in position 1, 2, 3, D, N, R, P: U_B with ignition on.	
Program switch in position E and 3-2-1: 0 Ω to ground, each.	
Throttle-valve potentiometer:	
Total resistance between pin 1 and socket 3 (between pins 1 and 2 in case of 6-pin plug):	3... 5 k Ω
Resistance between wiper socket 2 and socket 3 (between pins 2 and 3 in case of 6-pin plug): (Potentiometer removed and at stop).	250...800 Ω

For production reasons: continued on the following coordinate.

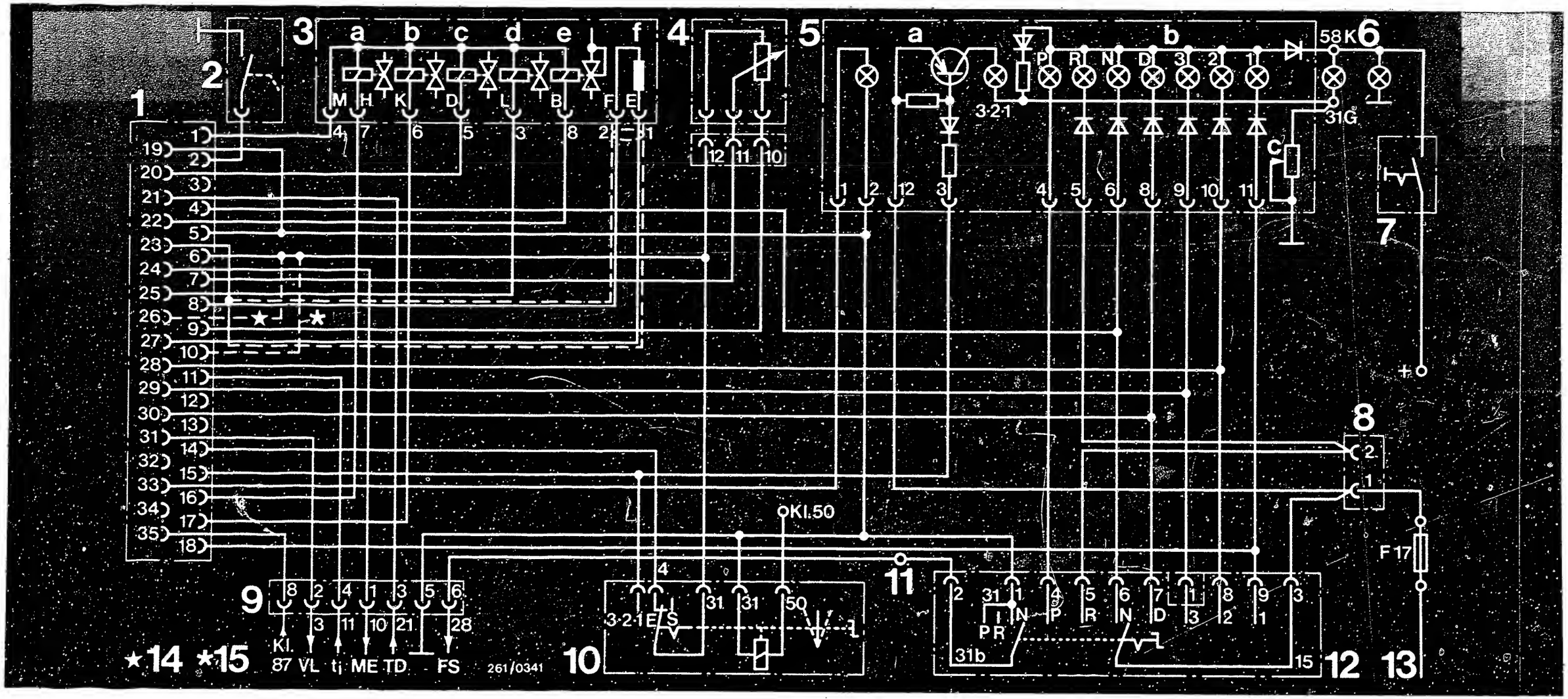


1 = Transmission control, wiring-harness plug, control-unit end
2 = Kick-down switch
3 = Transmission with plug connector (8-pin)
3a = Solenoid-op. valve 1
3b = Solenoid-op. valve 2
3c = Reverse-gear lock solenoid-op. valve
3d = Converter clutch solenoid-op. valve
3e = Pressure regulator
3f = Output RPM sensor
4 = Throttle-valve sensor
5 = Indicator unit
5a = Warning lamp for electronic transmission control
5b = Gear indicator

3. Electrical terminal diagram

D19 — ⟹

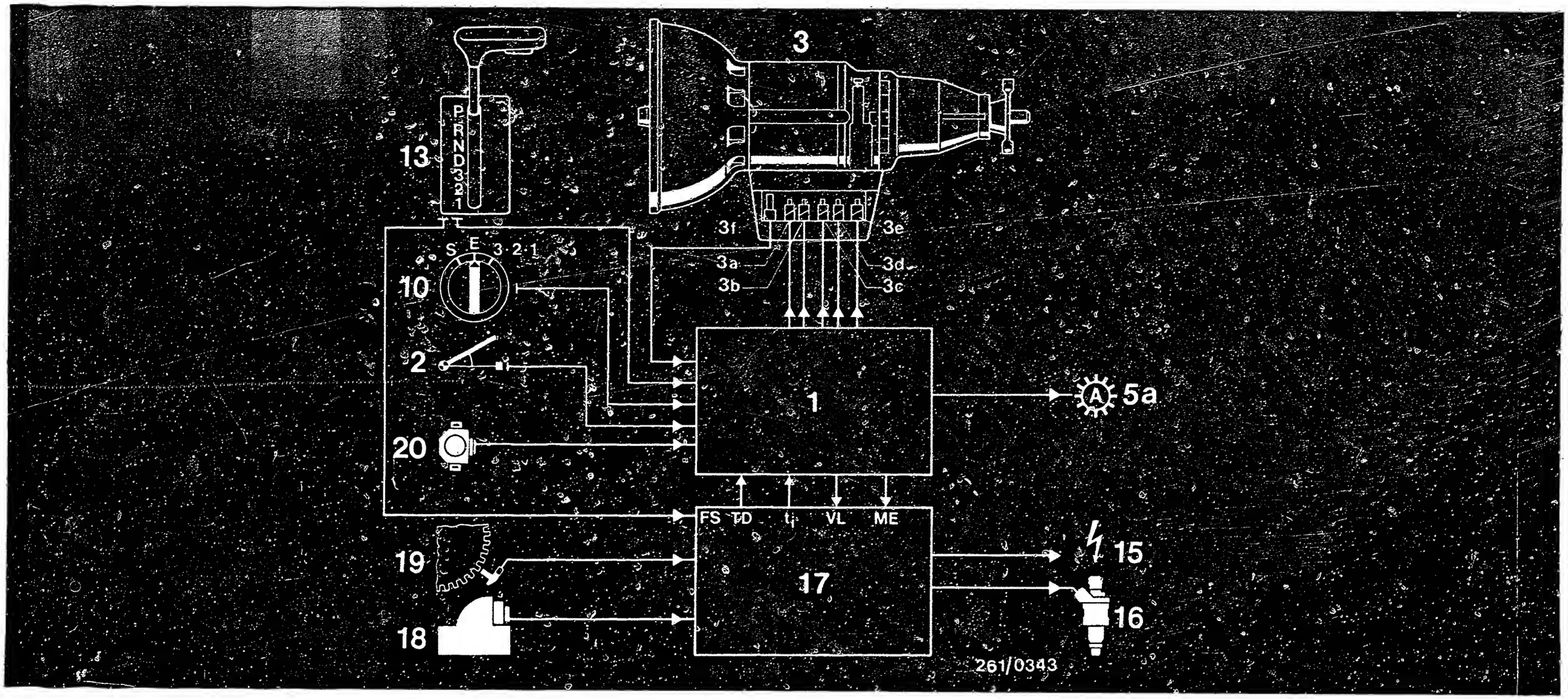
D20 — ⟺



5c = Brightness control
6 = Instrument and vehicle illumination
7 = Light switch (side-marker lights)
8 = Plug connector on center console to backup lamp
9 = Plug connector (13-pin) to Motronic wiring harness (term. 87 on main relay)
10 = Program switch
11 = To starting-disable relay term. 85
12 = Selector switch
13 = To ignition/starting switch term. 15
14 = 535i only
15 = 635 CSi only

t_i = Load signal
TD = RPM information
VL = Full-load output
ME = Torque control (Ignition-timing control)
FS = Driving-position information

Electrical terminal diagram (continued)



1 = Control unit for electronic transmission control
2 = Kick-down switch
3 = Transmission
3a,3b = Gearshift solenoid-op. valves
3c = Rev.-gear lock solenoid-op. valve
3d = Converter clutch solenoid-op. valve
3e = Pressure regulator
3f = Output RPM sensor
5a = Warning lamp for electronic transmission control

10 = Program switch
13 = Selector switch
15 = Ignition
16 = Gasoline injection
17 = Motronic control unit
18 = Air-flow sensor
19 = Engine-speed sensor
20 = Throttle-valve sensor

TD = Engine-speed information
t_i = Load signal
VL = Full-load output
ME = Torque control (ignition-timing control)
FS = Driving-position information

4. Basic circuit diagram

5. Installation position of components

Control unit for electronic transmission control: in glove compartment

RPM sensor, Sol.-op. valves, Press. regulator > in transmission

Main relay for transmission control and Motronic:

5 and 6 series : in glove compartment

7 series : on firewall

Selector switch : on driver's console
Program switch : on driver's console

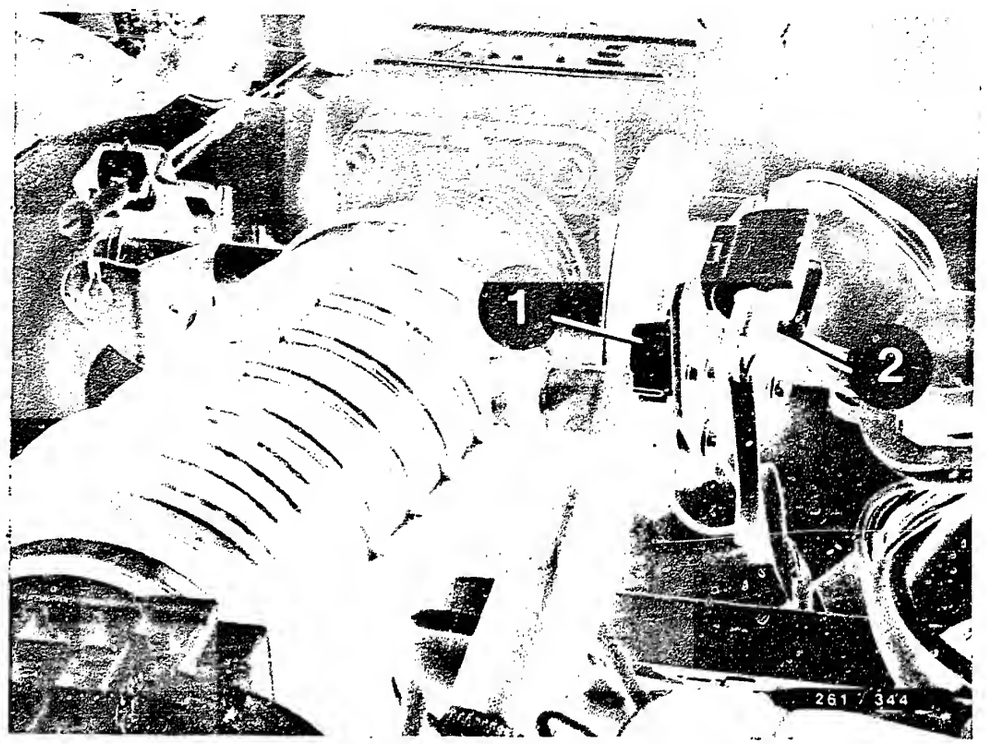
Indicator unit, Warning lamp for electronic transmission control > in dashboard

Kick-down switch: under accelerator

Throttle-valve potentiometer 1) : on throttle-valve assembly

1) = If throttle-valve sensor with 6-pin connector, pot and a microswitch (idle contact) are accommodated in a housing.

Note:
Adjustment is via idle contact, then check voltage at plug between term. 3 and term. 2 – switch on ignition:
Accelerator in rest position : < 1 V
Accelerator in full-load position: > 4 V



1 = Microswitch (idle)
2 = Potentiometer

The throttle-valve potentiometer (3-pin connection) is mounted on a mounting plate on the throttle-valve assembly and is covered by a rubber cover.
Adjust throttle-valve potentiometer as follows:
Connect universal test adapter and control unit.

Ω switch in position 22,
V switch in position 15.

Switch on ignition.

Slightly loosen fastening screws. Turn potentiometer until wiper voltage is 0.9 V.
Make sure that the throttle valve remains at idle stop while testing. Tighten fastening screws. Check wiper voltage at full load: 4...5.5V (is not adjustable).

6. Test equipment and tools

Description	Designation	Part number
Universal test adapter	ETT 018.01	0 684 101 801
Adapter lead	GS 1	1 684 463 161
Motortester	e.g. MOT 201 or MOT 300 and MOT 400	0 684 000 201 0 684 000 300 0 684 000 400
Multimeter (Internal resistance min. 20 k Ω /V)		Commercially available e.g. Metrawatt GmbH Type MA2H or Fluke Multimeter 75 or 77
Chassis dynamometer	e.g. LPS 96 or LPS 002	0 680 017 001 0 680 100 200

7. Important general information

Be sure to observe information in order to prevent damage to transmission, engine and control unit and in order to avoid risk to persons.

7.1 Never start engine without securely connected battery.

7.2 Incorrect polarity of supply voltage, e.g. through wrong connection of battery, may lead to destruction of control units.

7.3 Do not use a fast charger to start the engine. Give starting assistance only with second 12 V battery and jump leads.

C A U T I O N. !
Due to non-standardized requirements of vehicle manufacturers for electronic products, we advise you not to use 24 V batteries for starting assistance. Follow vehicle owner manual.

7.4 Disconnect battery from vehicle electrical system b e f o r e fast-charging. Follow operating instructions for fast charger.

7.5 Do not disconnect battery from vehicle electrical system with engine running.

7.6 Never disconnect or connect wiring-harness plugs of control units with ignition on.

7.7 Remove control unit at temperatures above 80°C (e.g. paint-drying installation).

7.8 Remove control unit before performing welding work (electric spot welding).

7.9 Transmission fluid
In automatic transmissions, even slight deviations from the specified fluid level or incorrect grade of fluid can lead to noticeable deterioration in quality of shifting. Major deviations may even lead to wrong shifting.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : BMW-530

BOSCH System : Motronic

Vehicle make : BMW

Basic microcard : BMW-512,BMW-514

SPECIAL FEATURES

This microcard contains the Motronic trouble-shooting instructions for the following models valid at the time of writing:

BMW 325e, 525e;
with catalytic converter and lambda closed-loop control; as of 12.84 - 2.7 l / 6-cyl. engine

Countries of application: Germany

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

The following rapid diagnosis chart makes it possible for the Motronic specialist to quickly test the electrical part of the system using the universal test adapter. If detailed information and instructions are necessary, the similar microcards BMW-512 and BMW-514 can be used
as aids.

The rapid diagnosis chart contains the following information:

* Test-step sequence.
* Position of the V- and Ω -program switch.
* Remarks on the operation of the universal test adapter and other components.
* Test specifications for motortester and multimeter.

Note:

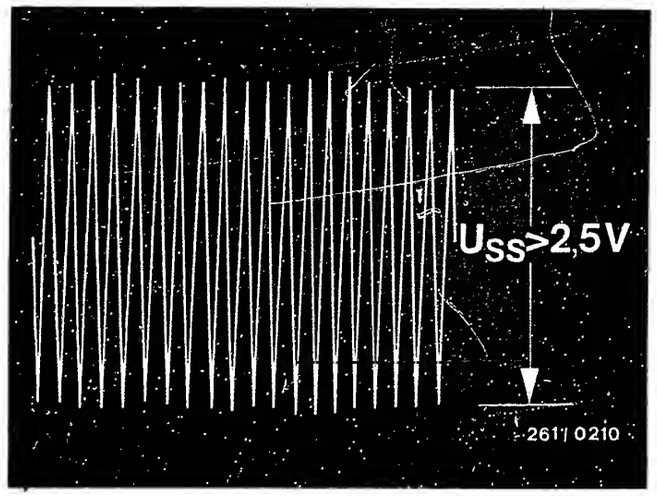
For vehicles with lambda closed-loop control, adapter cable 1 684 463 124 (instead of .. 128) can also be used; however, this requires that the lambda test steps be tested as well (see test steps 44a, 45a, 46a).

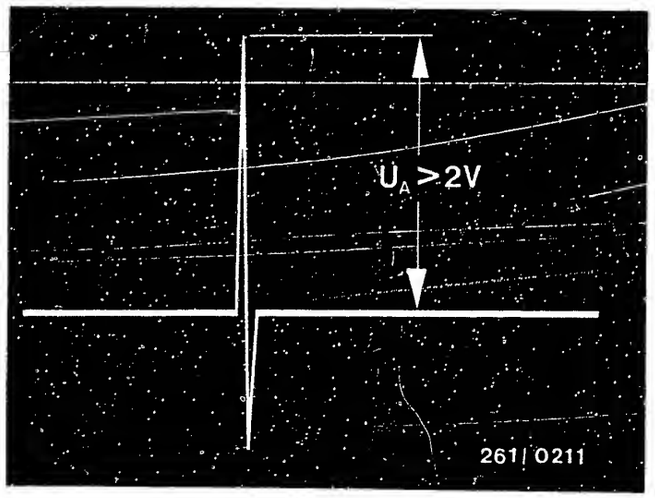
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurement at control-unit plug between terminals	Test specifications (reading)
1	| V	1	Disengage gear. Ignition off. Unplug control unit and pump fuse. Insulation resistance of engine-speed sensor.	8 <⟹> 5	greater than 1 M Ω
2	| V	2	Insulation resistance of reference-mark sensor.	25 <⟹> 5	greater than 1 M Ω
3	| V	3	Winding resistance of engine-speed sensor.	8 <⟹> 27	0,6...1,6 k Ω
4	| V	4	Winding resistance of reference-mark sensor.	25 <⟹> 26	0,6...1,6 k Ω
5	| V	5	Resistance of temperature sensor, engine (NTC II) Resistance is temperature-dependent.	13 <⟹> 5	(+15...+30°C): 1,3...3,6 k Ω (approx. +80°C): 250...390 Ω
6	| V	6	Resistance of temperature sensor, air (NTC I.) Resistance is temperature-dependent.	22 <⟹> 5	(+15...+30°C): 1,3...3,6 k Ω
7	| V	7	Resistance of characteristic-map switch.	10 <⟹> 5	325e: less than 10 Ω 525e: infinite Ω
8	| V	8	Not applicable		
9	| V	9	Throttle-valve switch. Resistance of idle contact. Accelerator pedal at rest: Throttle plate open slightly:	2 <⟹> 5	 less than 10 Ω greater than 1 Ω
10	| V	10	Resistance of full-load contact. Fully depress accelerator pedal.	3 <⟹> 5	less than 10 Ω
11	| V	11	Resistance of ground lead.	16 <⟹> 5	less than 10 Ω

Rapid diagnosis chart for universal test adapter (continued)

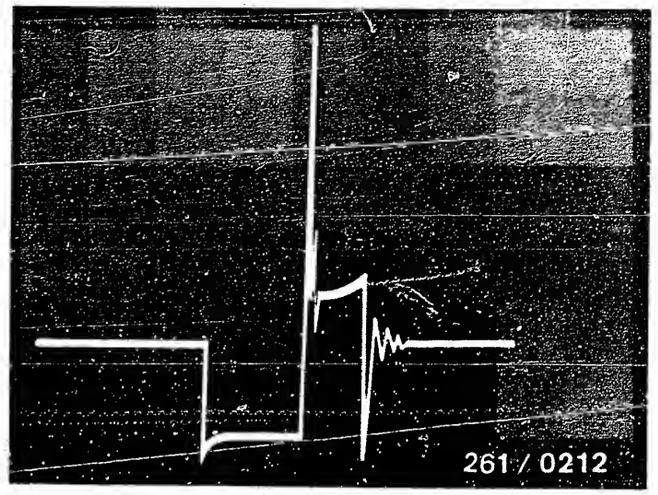
Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (readings)
12	| V	12	Resistance of ground lead	17 <⟹> 5	less than 10 Ω
13	| V	13	Resistance of ground lead	19 <⟹> 5	less than 10 Ω
14	| V	14	Resistance of altitude sensor (pressure sensor)	30 <⟹> 5	0,4...2,3 k Ω (altitude-dependent)
15	| V	14	Careful! Voltage measurement at ohm sockets (Altitude sensor; upper ill -2) Ignition on. In case of negative display, switch polarity. Test values depend on altitude and battery voltage. U_B = 10...14 V	30 <⟹> 5	0m: 1,5...3,5 V 500m: 2,5...5 V 1000m: 3,5...6 V 1500m: 4,5...7,5 V
16	1	15	Test engine-speed sensor signal with oscilloscope (middle ill.) Disengage gear and start.	8 <⟹> 27	See upper illustration
17	2	15	Test reference-mark sensor signal with oscilloscope (lower illustration). Disengage gear and start.	25 <⟹> 26	See lower illustration
18/19	3/4	15	Not applicable		





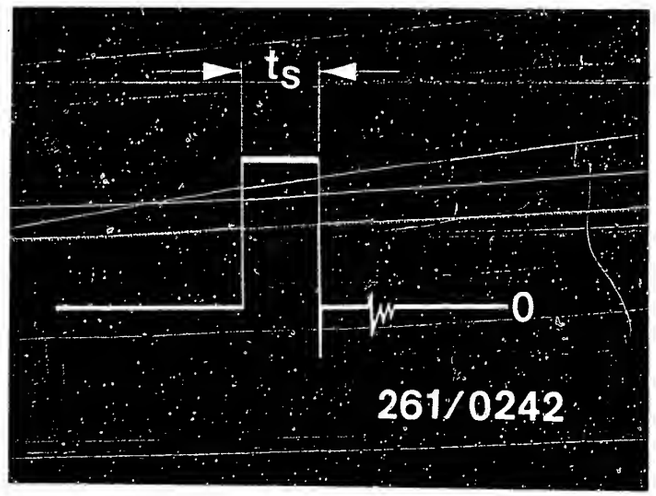
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurements at control-unit plug between term.	Test specifications (reading)
20	6	15	Main-relay voltage. Switch on ignition.	35 <⟹> 5	10...15 V
21	7	15	Main-voltage relay.	18 <⟹> 5	10...15 V
22	5	15	Test ignition signal with oscilloscope. (Control unit, connect ignition output stage from control unit with the ignition switched off, and start engine)	1 <⟹> 5	Signal present (see upper illustration)
23	8	15	Voltage supply for air-flow sensor.	9 <⟹> 5	greater than 8 V
24	9	15	Slider voltage from potentiometer in air-flow sensor. Ignition on. Sensor flap at rest : Sensor flap completely open:	7 <⟹> 5	 150...250 mV greater than 7 V
25/26	10/11	15	Not applicable		
27	12	15	Starting signal from term.50 Disengage gear and start.	4 <⟹> 5	8...15 V
28	13	15	Test dwell-period signal from control unit with oscilloscope. Disengage gear and start.	21 <⟹> 5	Signal present (see lower illustration)



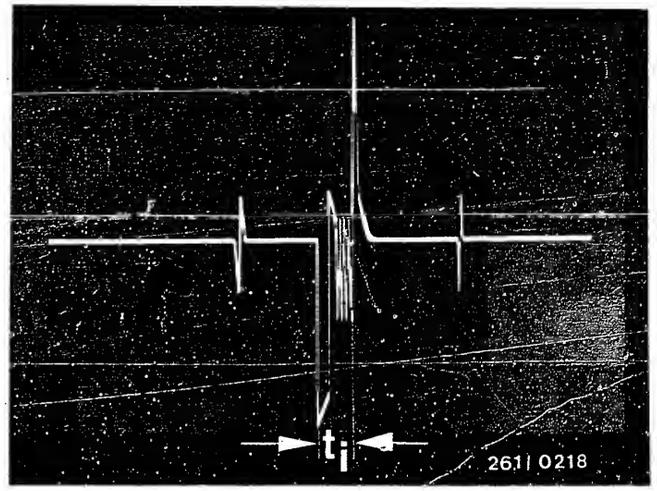
Ignition signal

Dwell-period signal
t_s = dwell period



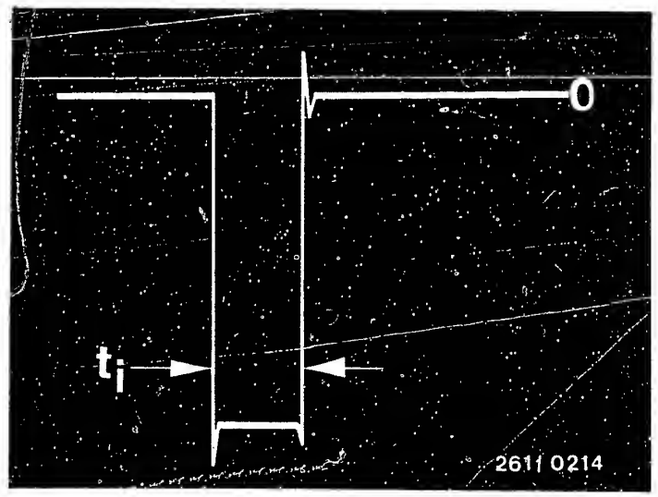
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurements at control-unit plug between term.	Test specifications (reading)
29	14	15	Test injection signal from control unit with oscilloscope. Disengage gear and start.	14 <⟹> 5	Signal present (see upper illustration)
30	14	15	As 29, except after pressing button T1 (NTC II, cold) the injection duration becomes somewhat longer. Press button for only about 2 seconds.	14 <⟹> 5	See upper ill.; t_i becomes somewhat wider.
31	15	15	As test step 29, except 2nd output for solenoid-operated injection valves	15 <⟹> 5	Signal present (see upper illustration)
32	16	15	Test injection signal (measurement output, control unit) using oscilloscope. Disengage gear and start.	11 <⟹> 5	Signal present (see lower illustration)
33	17	15	Voltage at pump relay. Plug in pump fuse. Ignition on.	20 <⟹> 5	10...15 V
34	17	15	Voltage at pump relay. Test of pump control in control unit. Disengage gear and start.	20 <⟹> 5	max. 4 V
35	17	15	Fuel-pressure test: Ignition off. Connect pressure gauge to test connection. Ignition on. Press button T3.	20 to ground	2,3...2,7 bar



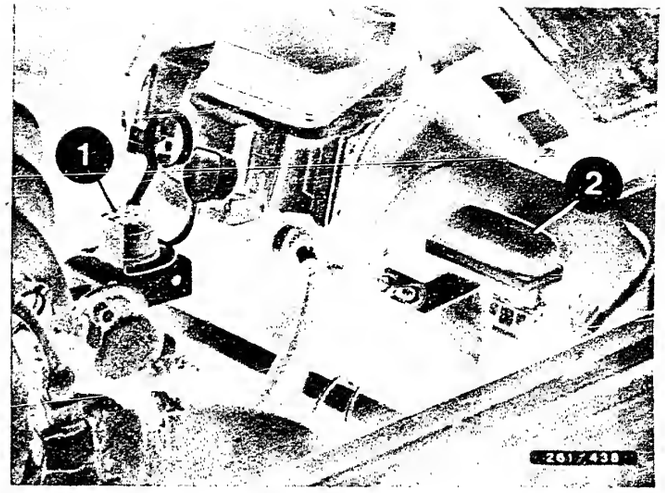
Injection signal
t_i = duration of injection

t_i = Duration of injection



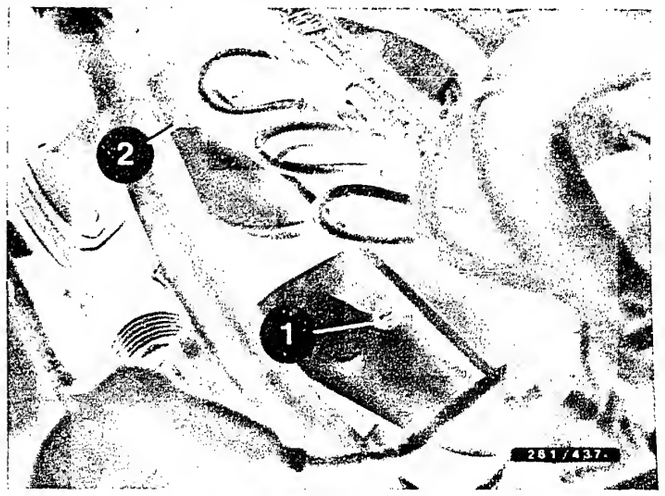
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurements at control-unit plug between term.	Test specifications (reading)
36	17	15	Test CO and idle speed: Connect motortester and (1*684 463 122) diagnostic cable Connect CO-tester to test connection before catalytic converter (if possible, join the two CO-sampling points, for example with the BMW exhaust-gas pickup/adapter). When testing with adapter cable 1 684 463 124 disconnect the plug connection of the lambda sensor Carry out CO measurement first. Engine at operating temp. Consuming devices switched off. Carry out adjustment work quickly.	———	0,2...1,2 vol%CO 650...750 min $^{-1}$
37	17	15	Test spark advance at idle speed: run engine at operating temperature and idle speed (650...750 min $^{-1}$). Engine speed must be correct, as otherwise the incorrect spark advance will be indicated.	———	4°...14° at idle speed
38	17	15	Test spark adv. at full load: Engine at operating temp. Set engine speed to 2700 min $^{-1}$. Press button T6.	3 to ground	7°...17° at 2700 min $^{-1}$
39	17	15	Dwell angle at idle speed: Dwell angle at 2700 min $^{-1}$:	——— ———	6°...18° 22°...42°



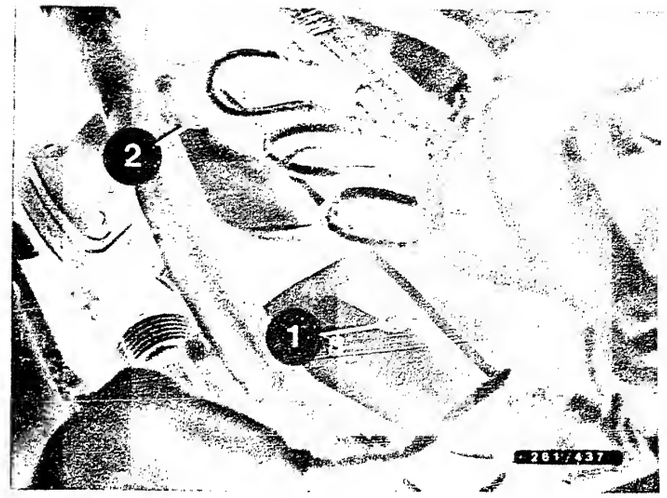
1 = Diagnostic connection
2 = Altitude sensor

CO-connections before cat. converter
1 = cylinders 1 + 2 + 3
2 = cylinders 4 + 5 + 6



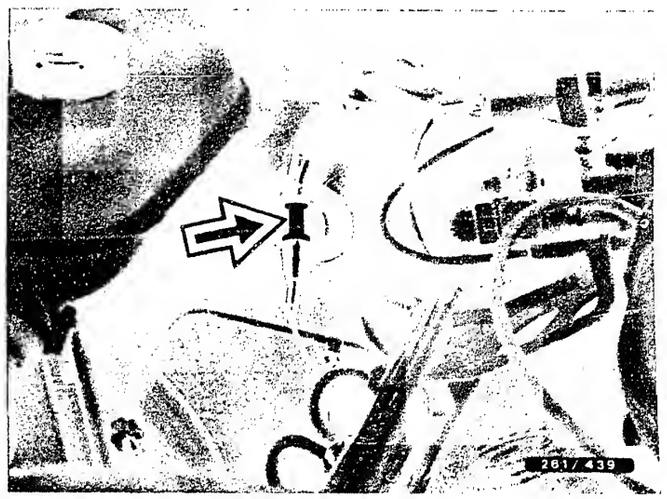
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurements at control-unit plug between term.	Test specifications (reading)
40	17	15	Test overrun cut-off: maintain engine speed at constant 2000 min $^{-1}$ .Press button T5. Injection signals discontinue and then come back on at about 1000 min $^{-1}$, etc.	2 to ground	Engine "surges"
41/42	18/ 19	15	Not applicable		
43	20	15	Only 325e: Test actuation of sensor-heating relay. Operate engine at idle speed.	31 <⟹> 5	max. 4 V
Testing of lambda closed-loop control can be carried out as follows: 1. With adapter cable 1 684 463 128 see test steps 44, 45, 46 2. Without test adapter, if only the adapter cable 1 684 463 124 is available, see test steps 44a, 45a, 46a With both test methods, connect the CO-tester before the catalytic converter and run the engine at idle speed and normal operating temperature.					
44	20	22	Testing with adapter cable 1 684 463 128: test of lambda closedloop control upper limit. Test adapter connects term.24 from control unit to ground. This test step must be kept brief in order to prevent damage to the catalytic converter.	24 to ground	CO rises above 1,2 vol.%CO (After approx. 10 sec., the control unit switches to open-loop control and the CO drops off)
45	20	23	As test step 44, except test of lambda closed-loop control lower limit. Test adapter applies +2 V to term. 24 of control unit	24 to +2 V	CO falls below 0,2 vol.%CO Uneven engine idling



CO-connections before cat. converter
1 = cylinders 1 + 2 + 3
2 = cylinders 4 + 5 + 6

Arrow = Lambda-sensor plug connection

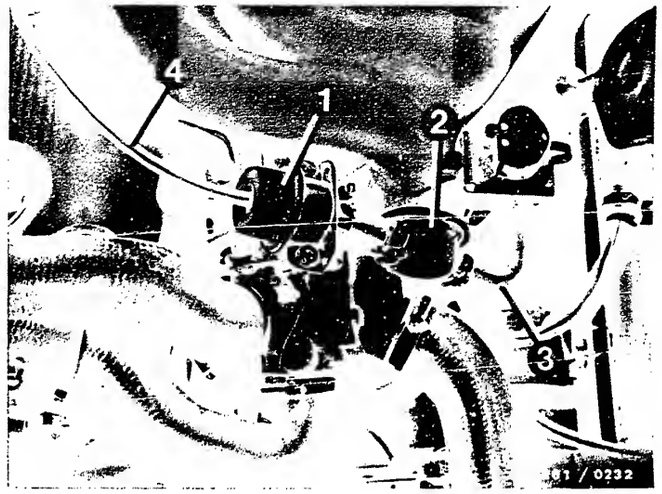


Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurements at control-unit plug between term.	Test specifications (reading)
46	20	24	Test of lambda sensor in closed-loop operation. Test adapter connects control-unit term. 24 to lambda sensor.	24 connected to lambda sensor.	0,2...1,2 vol.%CO
			As above, except pull air hose from pressure regulator and seal off. Immediately observe CO reading.		CO value rises briefly and then falls back to above closed-loop control value.

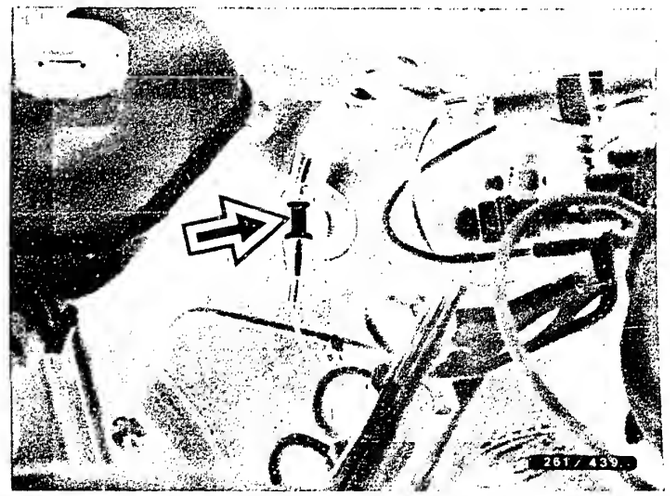
Testing of lambda closed-loop control without test adapter

44a	Test of lambda closed-loop control upper limit. Separate plug connection of lambda sensor and connect lead going to control unit (term. 24) to ground. Keep this test step brief to prevent damage to the catalytic converter. (After 10 seconds, the control unit switches to open-loop control, and the CO drops off.)	CO rises above 1,2 vol.%
45a	Test of lambda closed-loop control lower limit. Disconnected lead to control unit (term.24) must be connected to voltage of approx. +2 V (e.g. 1,5 V singlecell battery, positive to term. 24, negative to vehicle ground).	CO falls below 0,2 vol.% Uneven engine idling
47a	Test of lambda sensor in closed-loop operation. Re-connect lambda-sensor plug connection.	0,2...1,2 vol.%CO
	As above, except disconnect air hose from pressure regulator and seal off. Immediately observe CO reading.	CO value rises briefly and then falls back to above closed-loop control value.



1 = Pressure regulator
2 = Fuel-line-pressure damper
3 = Fuel return line
4 = Air hose to intake manifold

Arrow = Lambda-sensor plug connection



Idle speed: 650...750 min $^{-1}$

Exhaust-gas setting
CO value with engine at operating temperature and lambda sensor disconnected: 0,2...1,2 vol. %

Pressure regulator
Fuel pressure: 2,3...2,7 bar

Electric fuel pump
Delivery quantity (measured in return line): min. 750 cm ^{3} /30s
Pre-supply pump: approx. 825 cm ^{3} /30s
Connection voltage (under load): min. 12 V

Temperature sensor II (NTC II engine)
Electrical internal resistance:
At ambient temperature (+15°C...+30°C): 1,3...3,6 k Ω
Engine at operating temperature (approx. +80°C): 250...390 Ω

Solenoid-operated fuel-injection valveil
Electrical internal resistance:
At ambient temperature (+15°C...+30°C) 2...3 Ω

Start valve
Electrical internal resistance: approx. 4 Ω

Air-flow sensor
Electrical internal resistance
between terms.7 and 6: 8...2500 Ω *
terms.9 and 6: 500...1100 Ω

(* Deflect sensor flap all the way to stop).

Temperature sensor I (NTC I air)
Electrical internal resistance measured at air-flow sensor between terms.22 and 6 at ambient temperature (+15°C...+30°C): 1300...3600 Ω

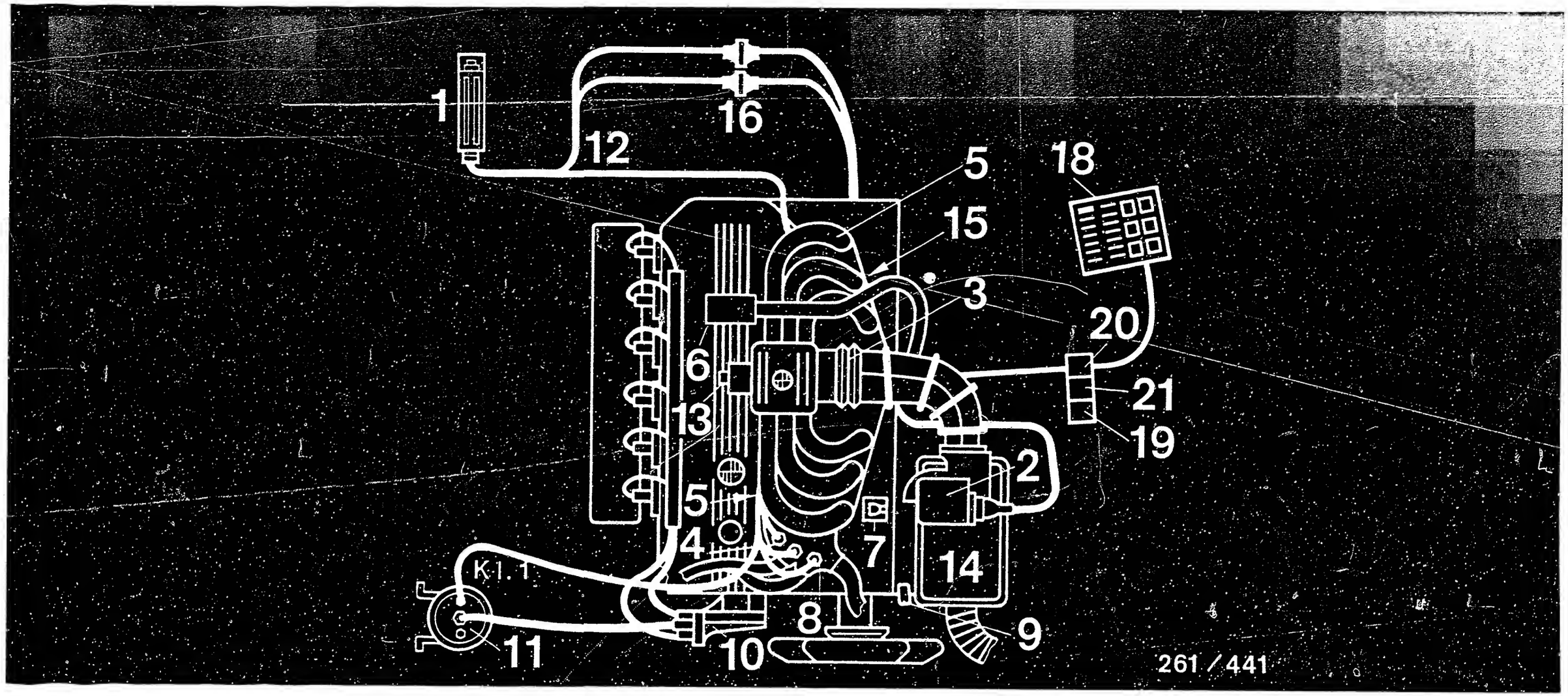
Engine-speed and reference-mark sensors
Electrical internal resistance at ambient temperature (+15°C...+30°C): 600...1600 Ω

Idle actuator (non-BOSCH product)
Electrical internal resistance at ambient temperature (+15°C...+30°C): approx. 9...10 Ω

Lambda sensor
Resistance of heating winding (325e): 1...15 Ω

Altitude sensor
Total resistance between term.3 (+) and term.2(-): 2,3...2,5 k Ω

Resistance between wiper term.1(s) and term.2 (-): 0,4...2,3 k Ω (altitude-dependent)



INSTALLATION POSITION OF COMPONENTS

1 = Control unit
2 = Air-flow sensor
3 = Throttle-valve switch
4 = Temperature sensor, engine
5 = Fuel-injection valves
6 = Idle actuator
7 = Diagnostic socket
8 = Thermo-time switch
9 = Altitude sensor
10 = High-voltage distributor
11 = Ignition coil
12 = Wiring harness
13 = Start valve
14 = Air filter
15 = Central ground
16 = Plug connections for engine-speed and reference-mark sensors
17 = Pump fuse
18 = Electrics console
19 = Main relay
20 = Pump relay
21 = Relay for sensor heating (325e only)

Installation position of components (continued)

Installation position is always given relative to the direction of travel.
Components that are not visible in the illustration are listed below.

* Reference-mark and engine-speed sensors:
In starting-motor ring-gear housing on circumference of flywheel ring gear.

* Fuel filter:
In engine compartment on left, near the firewall.

* Fuel pump:
Underneath the vehicle on the left, near the fuel tank.

* Electric fuel pump ground lead:
Underneath the rear seat on the left (depression), with ground point on body.

* Control unit:
In the glove compartment behind covering.

* Temperature sensor I (air):
In the air-flow sensor.

* Central ground:
On intake tube of cylinder 5.

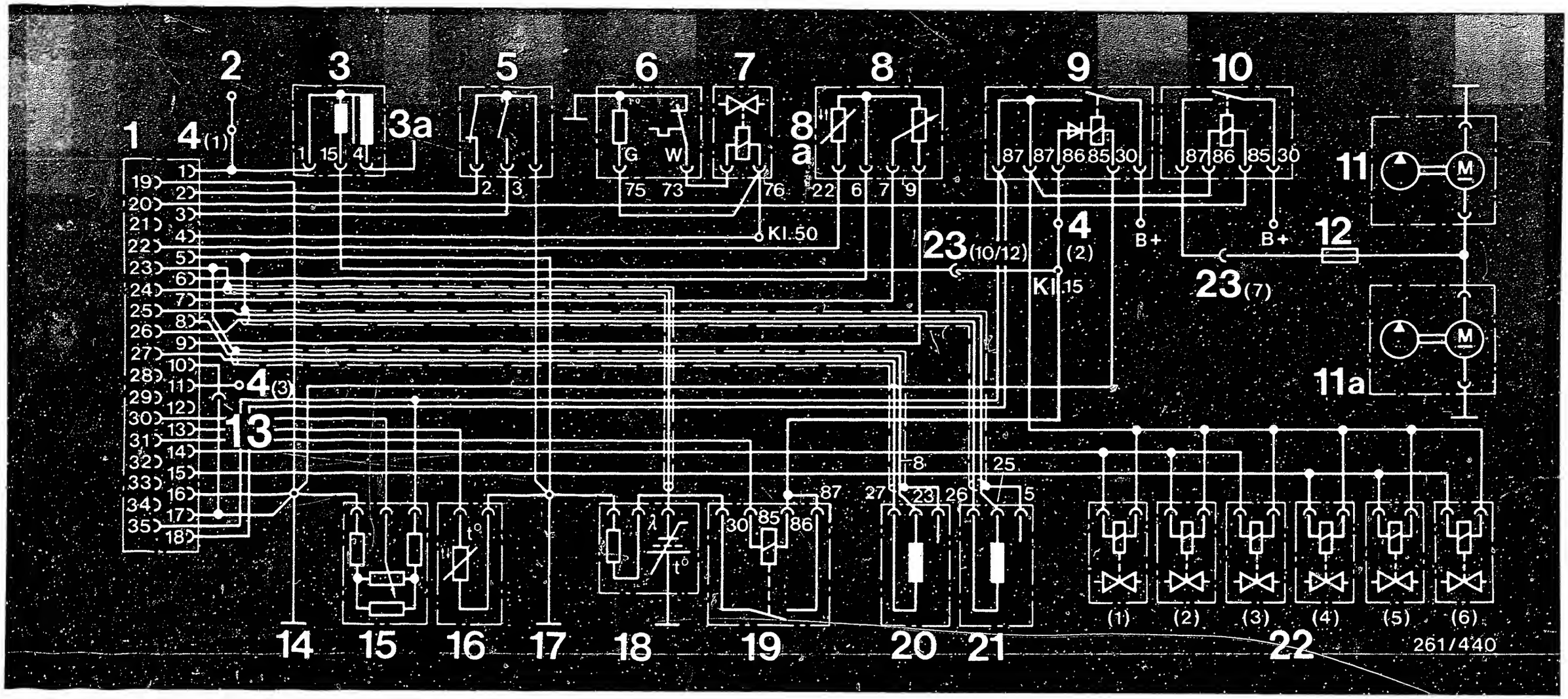
* Throttle-valve switch:
On bottom of throttle-valve assembly.

* Pressure regulator:
Near the plugs to the termo-time switch and engine-temperature sensor.

E21 — <==

For production reasons:
continued on the following coordinate.

E22 — => <=



ELECTRICAL TERMINAL DIAGRAM

1 = Control-unit plug
2 = To diagnostic plug and engine-speed sensor
3 = Ignition coil
3a = To high-voltage distributor
4 = Plug connection (3- or 6-pin) in glove compartment
5 = Throttle-valve switch
6 = Thermo-time switch
7 = Start valve
8 = Air-flow sensor
8a = Temperature sensor I (air)
9 = Relay 2 (main relay)
10 = Relay 1 (pump relay)
11 = Fuel pump
11a = Pre-supply pump
12 = Pump fuse F11
13 = Term. 10 not assigned on 525e
14 = Vehicle ground for control-unit output stage
15 = Altitude sensor
16 = Temperature sensor (coolant)
17 = Vehicle ground for control unit
18 = Lambda sensor (heated in 325 e only)
19 = Sensor-heating relay (325 e only)
20 = Engine-speed sensor
21 = Reference-mark sensor
22 = Solenoid-operated fuel-injection valves
23 = Engine plugs (No. 7, no. 10 in 325 e, no. 7, no. 12 in 525 e)

TEST EQUIPMENT AND TOOLS

Description	Designation	Part no.
Universal test adapter	ETT 018.01	0 684 101 801
Adapter cable, USA/Japan		1 684 463 128
Adapter cable (replacement for adapter cable 1 684 463 128)		1 684 463 124
Motortester	e. g. MOT 201	0 684 000 201
Diagnostic cable for measuring spark advance		1 684 463 122
Exhaust-gas tester	e. g. ETT 008.02 or ETT 008.03	0 684 100 802 0 684 100 803
Multimeter (internal resistance at least 20 k Ω /V)		Commercially available, e.g. Metrawatt GmbH Type NA2H or Fluke Multimeter 75 or 77
Pressure gauge, 6 bar or Pressure-measuring device or Pressure-measuring device (no longer available) Three-way cable as connector for KDJE-P 100 and KDEP 1034	Quality class 1.0 0.1 bar grad.	1 687 231 154 KDJE-P 100 KDEP 1034 KDJE-P 100/13

Test equipment and tools (continued)

Description	Part no.
Feeler gauge for measuring sensor air gap (up to 1 mm)	Commercially available
Lubricant for engine-speed and reference-mark sensors	Molykote Longterm 2, commercially available
Chassis dynamometer, e.g. LPS 96 or LPS 002	0 680 017 001 0 680 100 200
Test cable 2-pin, for measuring resistance and signals, e.g. of fuel-injection valves	1 684 463 093
Test cables for the correct connecting of test equipment to component plug connections	KDZS 0004 (2.8 mm wide) KDZS 0005 (6.3 mm wide)
BMW exhaust-gas pickup/adapter: BMW no. 130 090/130 100	
For USA/Japan: Tool set for removing and replacing the idle-CO anti-tamper device of the air-flow sensor, e.g. no. 13 1090 of the Cartol Co., Hans Schubert KG Unterer Grasweg 88, D-8070 Ingolstadt or from BMW of America	
Mounting paste VS 14016 Ft for lambda sensor and exhaust-gas screw plug	5 960 080 105
Spring clip for pinching off fuel and air hoses	Commercially available

Always pay attention to SAFETY AND PRECAUTIONARY MEASURES in order to avoid damage to the engine, control unit or ignition coil, as well as to prevent danger to persons.

1. CAUTION!
   High-output ignition system with dangerous high and low voltages!

   Contact with components or terminals under voltage may be dangerous (both at the primary and secondary ends).

2. When testing the compression, disconnect the Motronic relay. In this way, undesired injection by the injection valves is avoided.

3. Never start engine when battery not firmly connected.

4. Incorrect polarity of the supply voltage, e.g. through incorrect connection of the battery or ignition coil, may lead to the destruction of the control unit.

5. Never use a fast charger for starting the engine. Provide starting aid only using a second 12 V battery and jump leads.
   Caution! Due to non-uniform demands of the vehicle manufacturer made on electronic products, we recommend that a 24 V battery never be used for providing starting aid. Observe the vehicle owner's manual.

6. Disconnect the battery from the vehicle electrical system before boost charging.

7. When charging the battery in the vehicle or providing starting aid, observe the instructions in the operating manual of the fast charger, as well as the instructions from the vehicle manufacturer.

8. Never disconnect the battery from the vehicle electrical system when the engine is running.

9. Never short circuit ignition coil term. 1 to ground (e.g. for switching off the engine). Ignition coil and, under certain circumstances, control unit are destroyed.

10. Never connect the positive battery terminal to ignition coil term. 1. Control unit is destroyed.

11. Never diconnect or connect wiring-harness plug of control unit when ignition is switched on.

12. When temperatures are above +80°C (drying oven), the control unit must be removed.

13. When welding (electric spot welding), the control unit must be removed.

14. When installing an alarm system, observe the installation instructions for Motronic vehicles or the SIS microcard ALL-500.
    Make sure that the alarm relay is not destroyed by external fields (e.g. from ignition cables) so that it responds in a defective manner.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : FER-501

BOSCH System : ABS

Vehicle make : Ferrari

Basic microcard :

SPECIAL FEATURES

This microcard contains the ABS Trouble-Shooting Instructions, for the following model applicable at the time of publication:

Ferrari 412 i as of 9.85

TEST SPECIFICATIONS

For reasons of safety, the ABS must be tested only with the ABS tester. The rapid diagnosis chart contains all the immportant test specifications together with instructions for testing and trouble-shooting.

TEST REQUIREMENTS FOR TESTING WITH ABS 2 LED TESTER

* Regulatory tire size fitted?

* Check for firm seating and corrosion of ground of return-supply pump and of over-voltage protection relay term.31.

* Check for leaks in hydraulic connections and sealing points at hydraulic modulator (visual examination).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check the battery and power supply (generator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

  - Multipole plug sitting correctly on controller and latched?

  - All plug contacts O.K.?

  - Spring contacts latched?

  - Check installation position for correct seating of seal ring in controller plug: rounded side downwards.

  - Check for correct assignment of wheel-speed-sensor leads at controller plug.

    Wheel-speed sensor
    front left to term.6 and term.4.
    Wheel-speed sensor
    front right to term.11 and term.21.
    Wheel-speed sensor
    rear left to term.8 and term.9.

  - V-belt snapped?
    (Generator provides no voltage, charge-indicator lamp and ABS warning lamp light up.

* For checking, switch on ignition to all program-selector-switch positions (tester operates with current supply from vehicle battery).

* Observe LED (green) for current supply in all program-selector-switch positions.

* Connect ABS 2-LED tester to ABS wiring harness.

C A U T I O N !

Disconnect and connect controller only with ignition switched off.
Do not run with tester connected!
Repeat the complete test program after each repair.
The Antiskid System is a vehicle safety system.
Work on this system demands detailed know-ledge of the system.
The conventional brake system must be O.K.

General information for trouble-shooting:

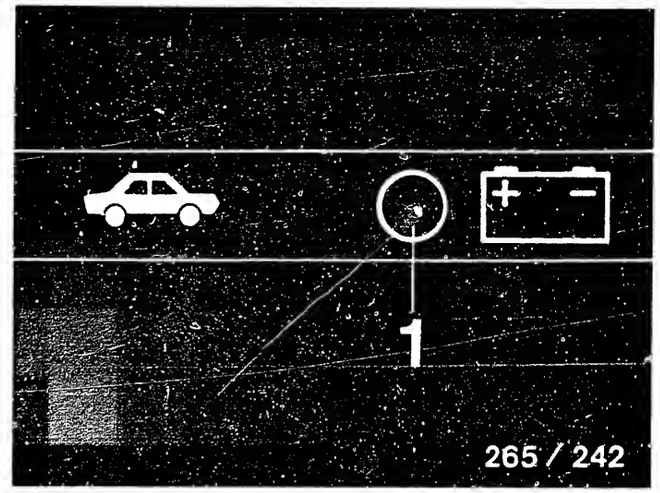
Check all leads for short circuit to ground and contact with positive lines and watch out for rubbed and pinched locations.

Rapid diagnosis chart

Do not run with tester connected! Are all test requirements complied with?

Program-selector-switch position 1 to 6

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinates)
Power supply (term. 1 and term. 20)	Ignition on	LED 1 (Upper illustration) Lights up continuously	*Fuse defective (——) *Battery insufficiently charged *Voltage drops too high (——) *Over-voltage protection relay defective (——) *Check lead to driving switch term. 15

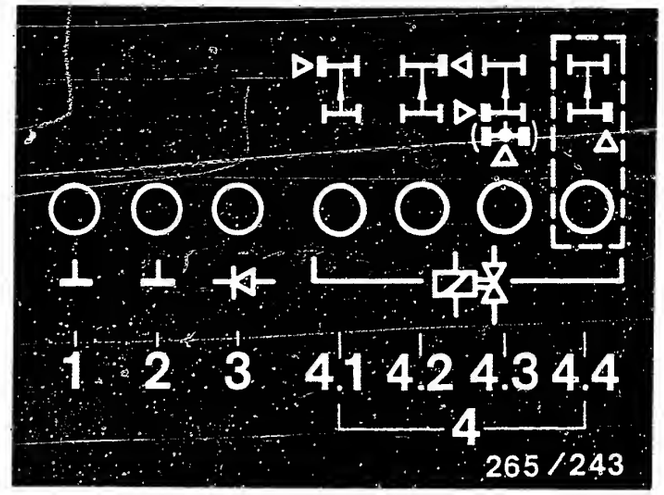


F05 —— ⟹

F06 —— ⟺

Rapid diagnosis chart (Continuation 1)

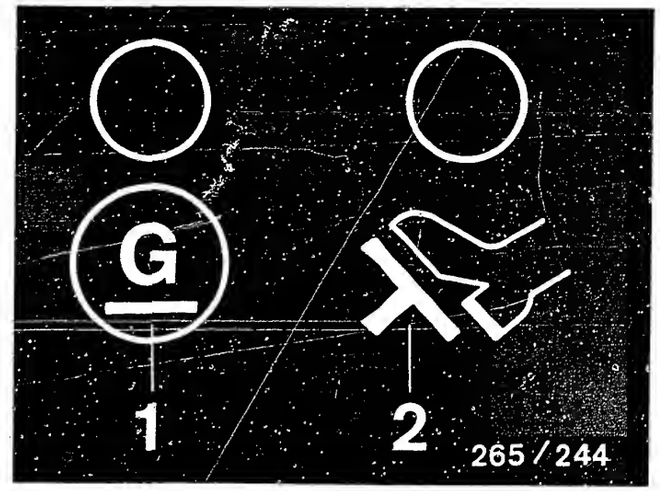
Program-selector-switch position 1 (3-channel hydraulic modulator)



Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Ground (term.10, term.4.3) Diode for warning lamp (term.29, term.32) Solenoid-operated valve - internal resistances (term.18, term.——, term.35) Off-position and ground of valve relay ABS warning lamp	Ignition on	6 LED (34 to 1) light up equally brightly (upper illustration) ABS warning lamp in vehicle must light up	* LED 1 and / or 2 (upper illustration) do not light up: Check ground terminals for short circuit. (——) * LED 3 (upper illustration) does not light up: Diode defective, check ground of valve relay. (2) * One or more LED 4 do not light up: Check corresponding plug connection for solenoid-operated valve and leads. (——) Solenoid-operated valve, internal resistance 0,7...1,7 Ω * All LED 4 and LED 3 do not light up: Check ground of valve relay, valve relay defective. (——) * Weak lighting of a LED means contact resistance in corresponding current path. (——) ABS warning lamp does not light up: Warning lamp defective. Note: All other 6 LEDs —— light up ( )

Rapid diagnosis chart (Continuation 2)

Program-selector-switch position 2

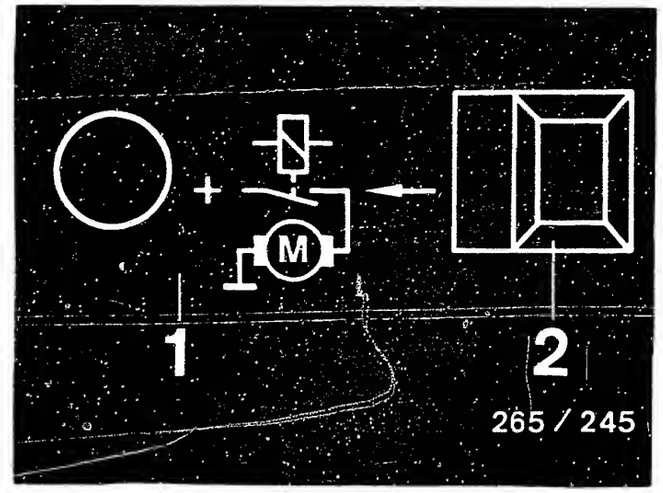


Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Generator voltage of term. 61 (term. 15)	Ignition on	LED 1 (upper illustration) lights up.	* LED 1 sometimes goes out only after snap acceleration (test is then O.K.) (——) * Check line to generator term. 61
	Start engine	LED 1 (upper illustration) goes out with engine running	* Generator defective
Stop-lamp switch (term.——)	Ignition on	LED 2 (upper illustration) lights up	* Check lead to stop-lamp switch. (25) * Stop-lamp switch defective
	Actuate brake pedal	LED 2 (upper illustration) goes out	* Lead at stop-lamp switch incorrectly connected

Rapid diagnosis chart (Continued 3)

Program-selector-switch position 3

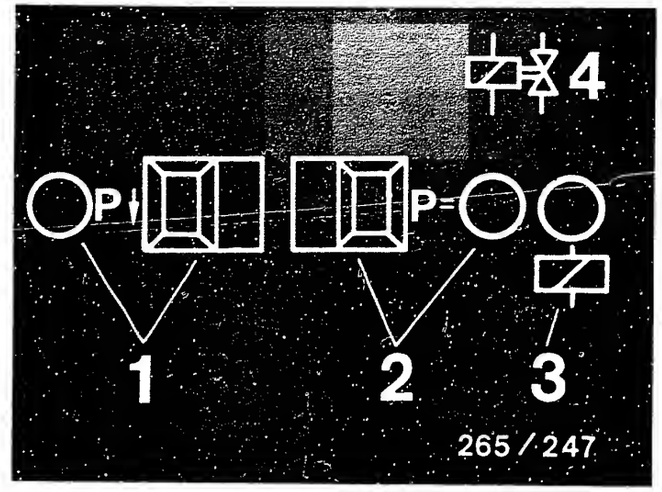
Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push-button 2 (upper illustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor armature (upper illustration)	* Motor relay defective (——) * Check ground and positive terminal of hydraulic modulator (——) * Check leads from controller term.14 and term.28 to hydraulic modulator term.9 or term.11. (——) * Pump motor defective (——)

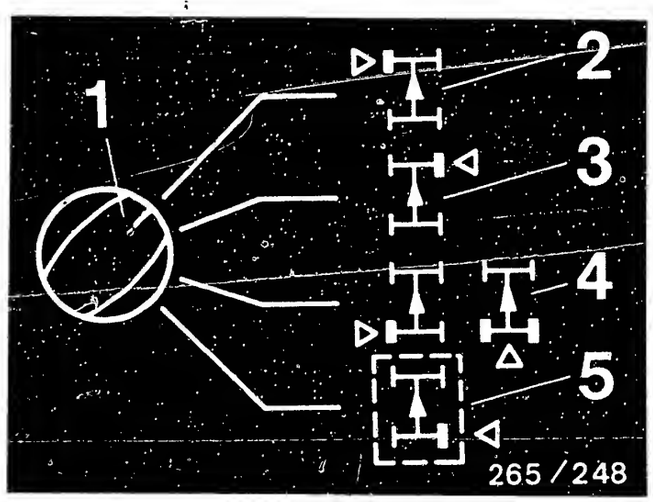


Program-selector switch position 4 not applicable

Rapid diagnosis chart (Continuation 4)
Program-selector-switch position 5 (3 channel hydraulic modulator)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Valve relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	Valve relay (winding) or leads defective (——) * Repeat test with engine running * Valve relay (make contact) defective (——) * Break in line from valve relay term. 87 to B+ (——) * Brake leads at hydraulic modulator mixed up (——) * Current value not obtained (LED P arrow or P= go out; upper illustration): Battery insufficiently charged. Repeat check with engine running. (——) * Solenoid-operated valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.—— Wheel, rear right: term.—— Rear axle: term.18 (——) * Hydraulic modulator defective(——)
Solenoid-operated valves in hydraulic modulator for function and mix-up. NOTE: Check each wheel seperately in turn. Keep to operating sequence	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set Switch 1 for wheel selection to wheel to be tested. (Lower illustration)		
Operation pressure holding	1. Constantly press push-button P= (upper illust.)	LED P= (upper illustration) lights up	
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illustration) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration)lights up, wheel turnable by hand	
	5.Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6.Release brake pedal		

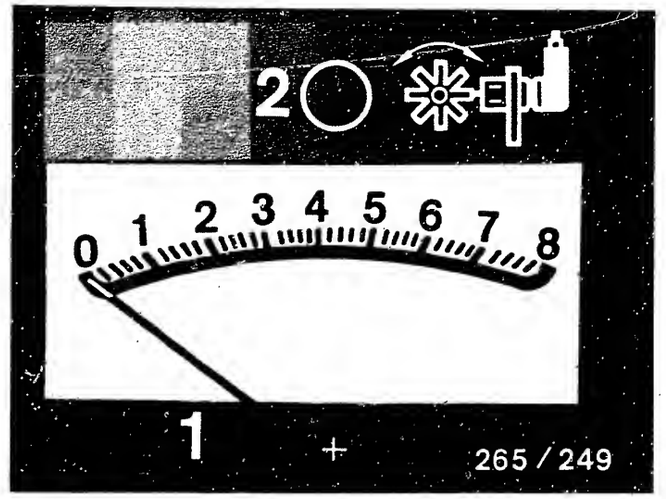


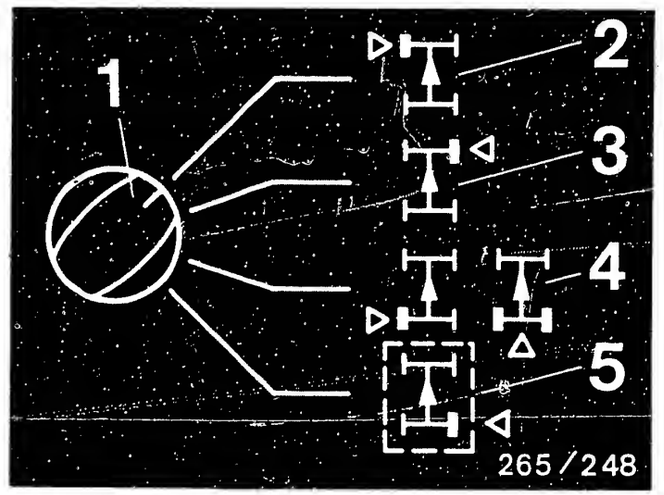


Rapid diagnosis chart (Continuation 5)

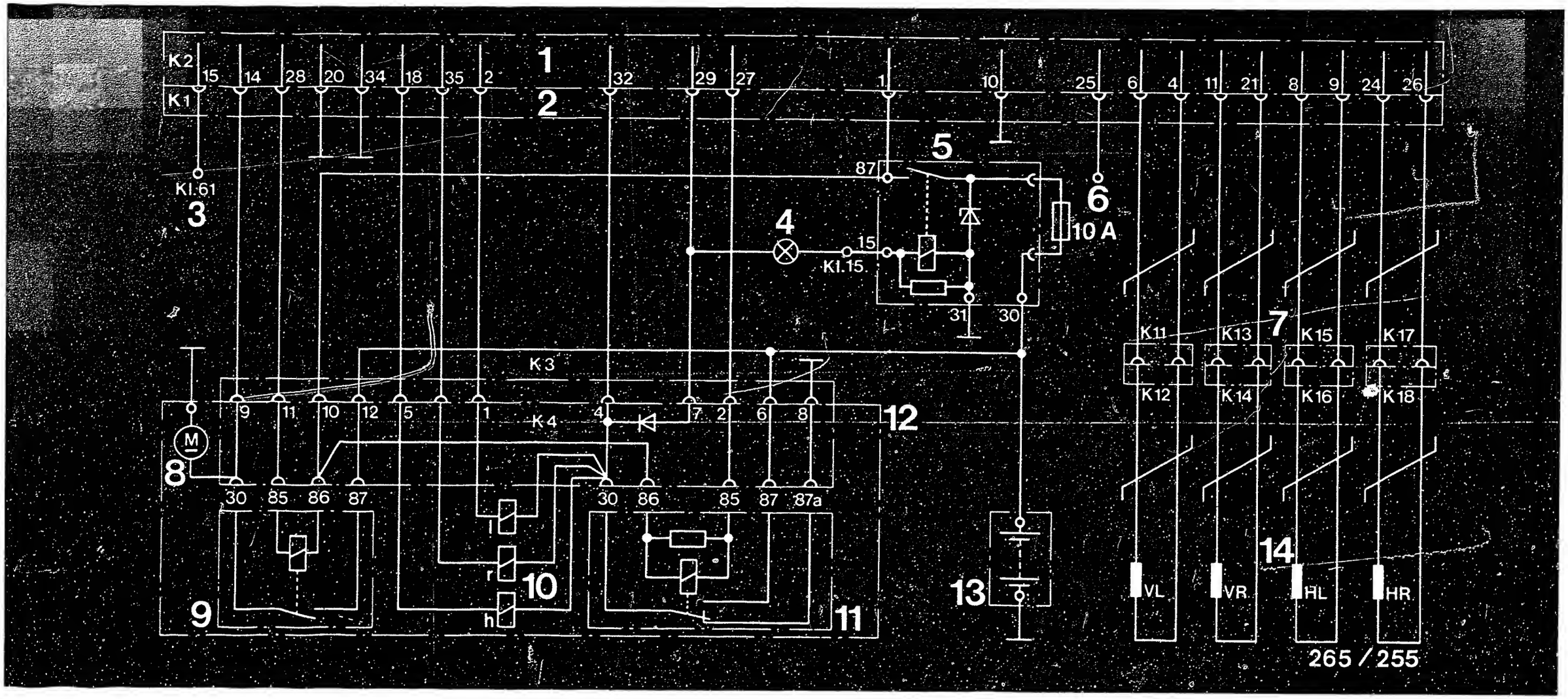
Program-selector-switch position 6 (4 wheel-speed sensors)

Test on (Measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term.4 and term.0,6...1,6) Wheel, front right: term.11 and term.21) Wheel, rear left: term.8 and term.——) Wheel, rear right: term.24 and term.——	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)	1.Smallest reading larger 1,6 divisions 2.Permissible fluctuation max.0,6...1,6 from largest reading.	*Wheel-speed-sensor lead mixed up (——) *Break in wheel-speed-sensor lead (——) *Wheel-speed sensor defective(——) Winding resistance Front axle: 25 k Ω Rear axle: 6 k Ω *Air gap between wheel-speed sensor and ring gear too wide (9) *Ring gear defective or loose (26) *Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth (——) *Wheel-bearing clearance too large





Take for road test for final check. With the engine running, the warning lamp must go out. Drive at at least 30 km/h. The warning lamp must not light up again!



1 = ABS controller
2 = Multiple plug (35-pin)
3 = to alternator
4 = ABS warning lamp
5 = Over-voltage protection relay
6 = to stop-lamp switch (+)
7 = Multiple butt connector
8 = Return-supply-pump motor
9 = Motor relay
10 = Solenoid-operated valve
11 = Valve relay
12 = Hydraulic modulator
13 = Battery
14 = Wheel-speed sensor

VL or l = front left
VR or r = front right
HA or h = rear axle
HL = rear left
HR = rear right
K1 to K18 = ABS plug connections

ELECTRICAL TERMINAL DIAGRAM

TEST EQUIPMENT AND TOOLS

Designation	Code	Part number
ABS2 LED tester	KDAS 0003	Procure. address: Robert Bosch GmbH KH/VKD 3 Postfach 41 09 60 7500 Karlsruhe 41
Adapter lead (included in scope of delivery of tester)	KDAS 0003/2	
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 1)
Bleeder fitting for connection of charging and bleeding device to fluid reservoir of brake master cylinder		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 1)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal-actuating device		ATE Part No. 3.9312.0100.4 1)

1) = obtainable from: Alfred Teves GmbH,
Guerickestr. 7
D-6000 Frankfurt (Main)

Test equipment and tools (continued)

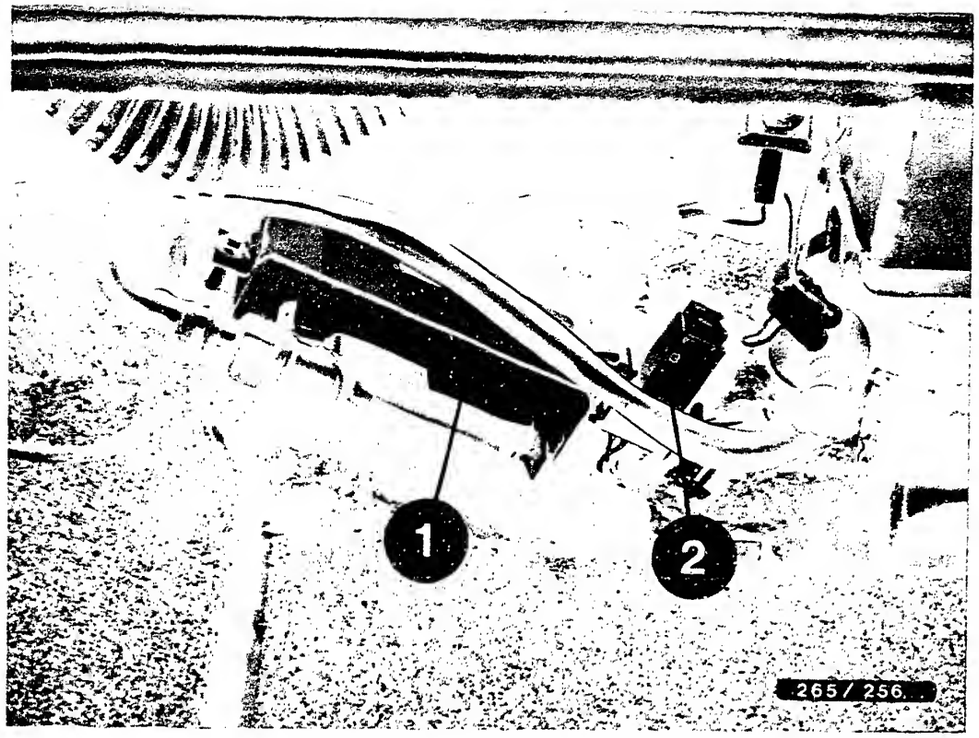
Designation	Code	Part number
Pressure tester Tester for checking low-pressure and high-pressure at hydraulic brake systems		e.g., ATE Part No. 3.9305-0200.4 1)
Flat double-end flare nut wrench, 9 x 11 mm		Hazet Part No. 612 2)
Container, approx. 1l for catching the brake fluid		
Brake fluid Use only DOT 4 or brake fluid from the vehicle manufacturer.		
Electrics tester or multimeter for trouble-shooting	ETE 014.00	0 684 101 400 commercially available

Aids!
Use only original brake lines from the vehicle manufacturer!

Grease for wheel-speed sensor	Molykote Longterm 2
Protective caps for brake lines	1 900 508 002 (100 pieces)
Protective caps for brake-line connections at hydraulic modulator	1 900 508 004 (100 pieces)

1) obtainable from: Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

2) obtainable from: Hazet Co, D-5630 Remscheid



INSTALLATION POSITION OF COMPONENTS

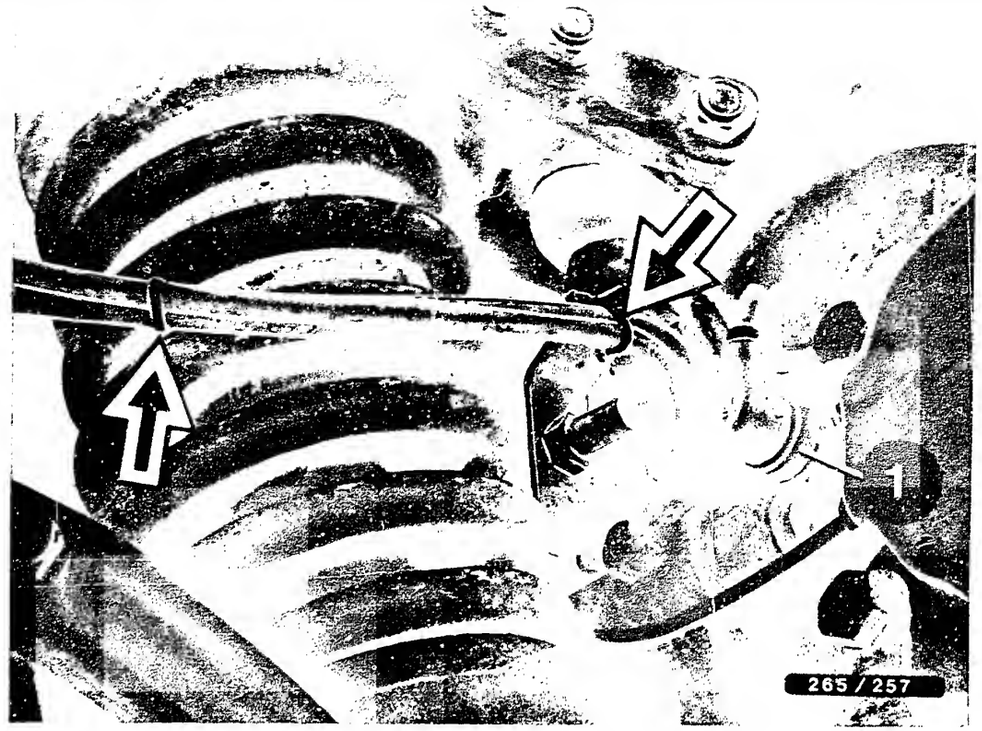
Details of the installation position are always with reference to the forward direction of travel.

1 = Controller:
In the luggage compartment

2 = Over-voltage protection relay:
To the right of the controller in the luggage compartment

ABS warning lamp:
In instrument panel

ABS ground terminal:
Under the vehicle between the differential and fuel tank at the transverse member.



1 = Wheel-speed sensor, front right.
Take care that the wheel-speed sensors of the front wheels are not swopped between left and right during installation. Signal becomes too small!

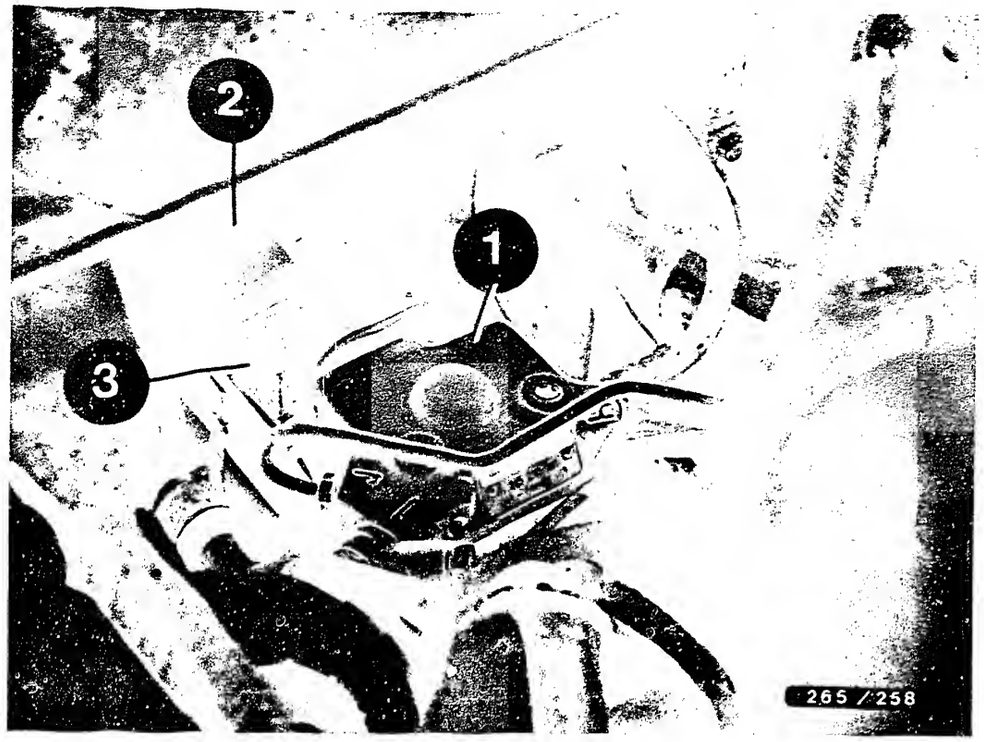
Arrow = Fastening points of the wheel-speed-sensor lead

* Wheel-speed sensors, front axle:

One on both sides in the steering knuckles. Plug connections are underneath the vehicle to the left and right of the oil pan at the transverse member.

* Wheel-speed sensors, rear axle:

One on both sides next to the McPherson struts. Plug connections are underneath the vehicle between the differential and fuel tank at the transverse member. Caution! Do not mix up plug connections. Observe coding, L (left) and R (right)!



1 = Hydraulic modulator :
In the engine compartment, under the left headlamp.
1 = Brake line to wheel brake cylinder front left
r = Brake line to wheel brake cylinder front right
h = Brake line to wheel brake cylinders of rear axle.

2 = Motor relay
3 = Valve relay

The hydraulic modulator must not be repaired, but be exchanged only as a complete unit.

Exception: Change of relay

Note on removal:

Unscrew radiator grille and remove fan in left-hand wheel box.

GENERAL INFORMATION FOR REPAIRS AND ON BRAKE SYSTEM

The ABS is basically maintenance-free, however, when working on vehicles with ABS system the following must be noted:

1. When welding with electric welding equipment, pull plug from electronic controller.

2. When painting, the electronic controller may be loaded for a short time to max. + 95°C and for a long time (approx. 2 hours) to max. 85°C.

3. After exchange of hydraulic modulator, controller, wheel-speed sensor and of the wiring harness, as well as after work in which the ABS units are touched (e.g. accident repairs), check the complete ABS system with the tester.
Pay attention to correct assignment of brake lines and wheel-speed-sensor connections at controller as well as wheel-speed-sensor plug connections (see vehicle-specific terminal diagram).

4. Each time after working on the brake system, the latter must be bled and go through low-pressure and high-pressure tests. Check all connections for leaks..

5. Tighten battery terminals to terminal posts of battery.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system when the engine is running.

8. When fast charging, disconnect the battery from the vehicle electrical system.

9. Take care that all connectors of the wiring harness are seated perfectly.

10. Never disconnect or connect the ABS wiring-harness plug from the controller when the ignition is switched on.

11. <u>For reasons of safety, the hydraulic modulator must never be repaired, but be exchanged only as a complete unit.</u>

    Excepted from this are the motor relay and the valve relay.
    Both relays may be exchanged.
    Apart from the brake-line connections, <u>no screws at the hydraulic modulator may be loosened.</u>
    Once they are loosened, it is impossible to make the brake circuits leak-free ever again!

<u>There is d a n g e r t o l i f e !</u>

For production reasons:
continued on the following coordinate.

TA B L E O F C O N T E N T S

Trouble-shooting instructions : FOR-5002

BOSCH system : KE-JETRONIC

Make of vehicle : FORD

Basic microcard : AUD-507

SPECIAL FEATURES

These instructions contain the trouble-shooting, valid at the time of publication, for the KE-Jetronic (system version KE 2.6) for the following vehicle models:

* FORD Escort Sedan, Convertible, Station Wagon
  XR 3 i - 1.6 Injection (1.86 ->)

* FORD Orion 1.6 Injection (9.85 ->)
  Engine: 4 cyl./1.6 l/ 66kW/90bhp, with catalytic converter and lambda closed-loop control.

- The KE-Jetronic of these models corresponds to the basic version with additional lambda closed-loop control.

- When trouble-shooting, remember that the wiring of the KE-Jetronic and of the electronic ignition system (EI-K) is to some extent common to both. Various electric leads are shielded, in part several leads with one common shield (see terminal diagram).

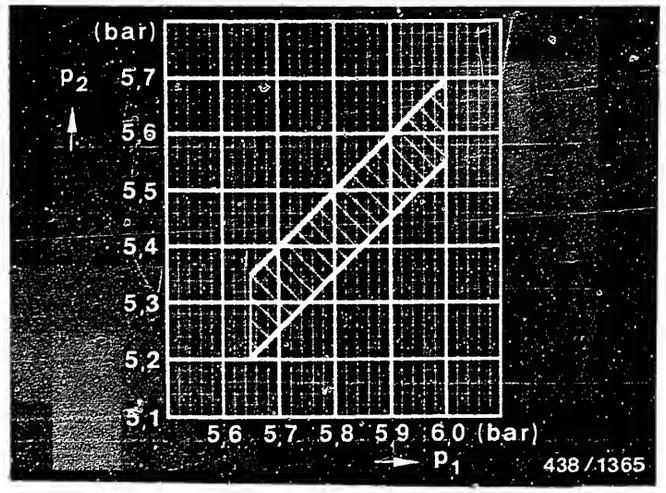
- The vehicles are equipped with a 5-pin diagnosis connection (left-hand wheel house, in area of McPherson strut).
  Pin 4 = lambda measurement output (integrator voltage) for adjustment of the closed-loop control without universal test adapter.

Important note:

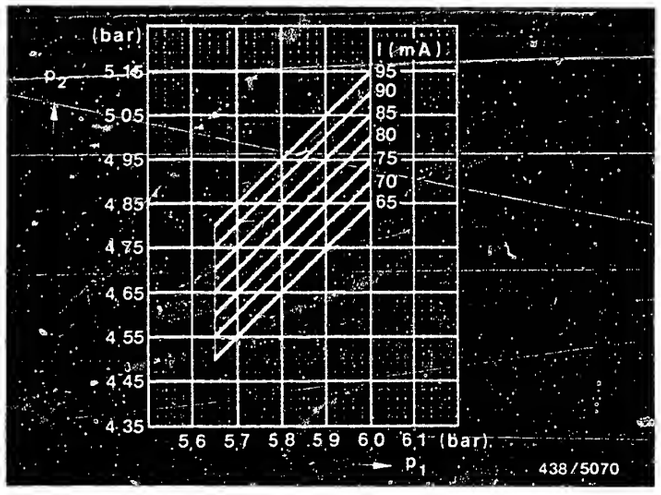
If reference is made to similar, detailed instructions (given in KFZ 000), always make sure you use the test specifications from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Testing/Test condition	Test specification	
1	Fuel delivery – electric fuel pump:	at least 800 cm ^{3} /min	
2	Primary pressure:	5,65...6,0 bar	
3	Differential pressure: Take lower chamber pressure set value "warm", in accordance with primary pressure measured, from upper chart. (Actuator current 10 mA) Take lower chamber pressure set value "cold", in accordance with primary pressure and actuator current measured, from lower chart. Tolerance ± 0.15 bar. Simulation of "cold" state: disconnection of lead plug at engine temperature sensor.		
4	Leakage test, total system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 2,7 bar 2,6 bar	
5	Injection valves, opening pressure:	3,0...4,1 bar	
6	Comparative measurement of fuel deliveries: (Actuator current 0 mA)	Adjustment point: (cm ^{3} /min)	Max. perm. quantity: (cm ^{3} /min)
	Idle: Part load: Full load:	6,0 40,0 100,0	6,0 40,0 109,0
	Minimum quantity at max. air-flow sensor plate deflection:	130,0 cm ^{3} /min	



p_1 = Primary pressure
p_2 = Lower-chamber pressure



TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification	
7	Rate of flow, KE restriction:	130... 150 cm^3 /min	
8	Temperature sensor, engine (NTC):		
	Engine cold (+15... +30°C):	1,3... 3,6 k Ω	
	Engine warm (approx.+80°C):	250... 390 Ω	
9	Thermo-time switch - resistance measurement:	Below +30°C	Above +40°C
	Terminal G and ground:	25... 40 Ω	50... 80 Ω
	Terminal W and ground:	0 Ω	100...160 Ω
	Terminal G and terminal W:	25... 40 Ω	50... 80 Ω
10	Idle-mixture-adjusting screw basic setting:		
	Fuel-distributor seat - needle bearing:	18,7...18,9 mm	
11	Air-flow sensor potentiometer:		
	Voltage signal, air-flow sensor flap basic setting:	0,01...0,05 V	
12	Auxiliary-air device:		
	Resistance of heater winding:	30...65 Ω	

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
13	Idle adjustment: *)	
	Idle speed: (Without fan operation. Adjustment at bypass screw, throttle-valve assembly reverse side)	875...925 min $^{-1}$
	Exhaust-gas adjustment: (Adjustment at idle-mixture-adjusting screw)	
	* Current measurement - mean-value test: adjustment:	4...16 mA 9...11 mA
	* Voltage measurement - mean-value test: mean-value adjustment:	Approx. 4,5 V Approx. 4,5 V
	* CO concentration in exhaust gas - check value:	0 % by vol.

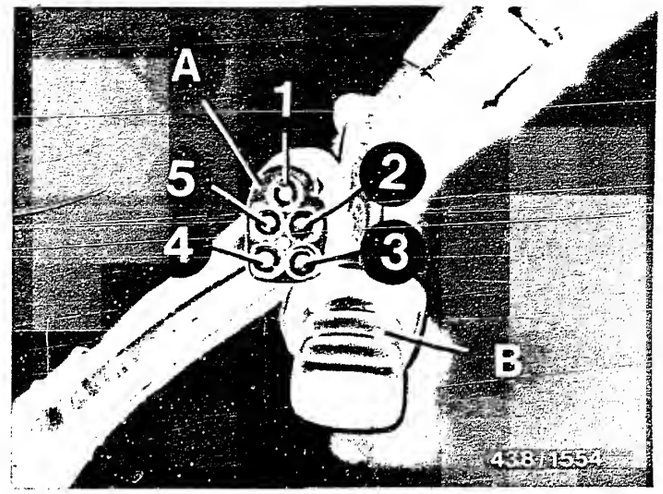
*) Information on idle adjustment:

Testing and adjustment without fan operation. If necessary, briefly disconnect the lead plug at the temperature switch (radiator).

Exhaust-gas closed-loop control is carried out automatically by the lambda closed-loop control. Check the control function with the engine and exhaust-gas system at normal operating temperature. Closed-loop control mode can be recognised from the oscillating measured-value reading. Adjustment is made with reference to the mean value of the oscillating measured-value reading by adjusting the idle-mixture-adjusting screw in the mixture-control unit.

Either the pressure-actuator actuating current can be tested using the universal test adapter, or alternatively, so that the adapter does not need to be connected, the voltage can be measured at pin 4 (+) of the diagnosis connection (see illustration).
For voltage measurement, use analog voltmeter with R_i = at least 20k Ω, e.g. BOSCH lambda closed-loop control tester KDJE-P 600.

CO check value serves to check as to whether there are leaks in the exhaust-gas system. Test at exhaust end pipe.



A = Diagnosis connection at wiring harness, left wheel house
B = Cap

1 = Diagnosis, ignition system
2 = Speed signal (TD)
3 = Ground
4 = Lambda signal
5 = NTC signal (coolant)

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE2 ADAPTER CABLE 1 684 463 135 AND SUITABLE MULTIMETER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic specialist to rapidly test the electrical/electronic peripheral and control-unit functions of the KE-Jetronic, including lambda closed-loop control.

Important information concerning the following rapid diagnosis chart:

The "test conditions" column specifies the test steps during which the control-unit plug must be connected or disconnected. Great care must be taken to ensure that the system is without current during all plugging and unplugging operations, i.e. the ignition must be switched off and the electrical safety circuit must not be bridged.

The "test connections" column indicates the leads in the current path for the measurement being made, with reference to the pin assignment of the control-unit plug. Any trouble-shooting that may be required will involve these leads.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Switch/Btn Ω	Switch/Btn Btn	Under test	Test connections	Test conditions	Test specifications
1	| V	4	–	Pressure actuator internal resistance (R_i)	12 – 10	Disconnect control-unit lead plug.	20...30 Ω
2	| V	5	–	Temperature sensor, engine (NTC) internal resistance	21 – 2	Control-unit lead plug disconnected. Engine temperature +15...+30°C: approx. +80°C:	 1.3...3.6 k Ω 250...390 Ω
3	| V	9	–	Throttle-valve switch, idle	13 – 2	Attention: Ohmmeter connection: Left-hand blue socket " Ω ", black socket "V". Control-unit lead plug disconnected. Throttle valve closed: Open throttle valve manually:	 0...10 Ω infinite Ω
4	| V	10	–	Throttle-valve switch, full load	5 – 2	Attention: Ohmmeter connection: Left-hand blue socket " Ω ", black socket "V". Control-unit lead plug disconnected. Throttle valve closed: Fully open throttle valve manually:	 infinite Ω 0...10 Ω
5	4	—	–	Start signal, terminal 50	24 – 2	Control-unit lead plug disconnected. Actuate starting motor:	 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

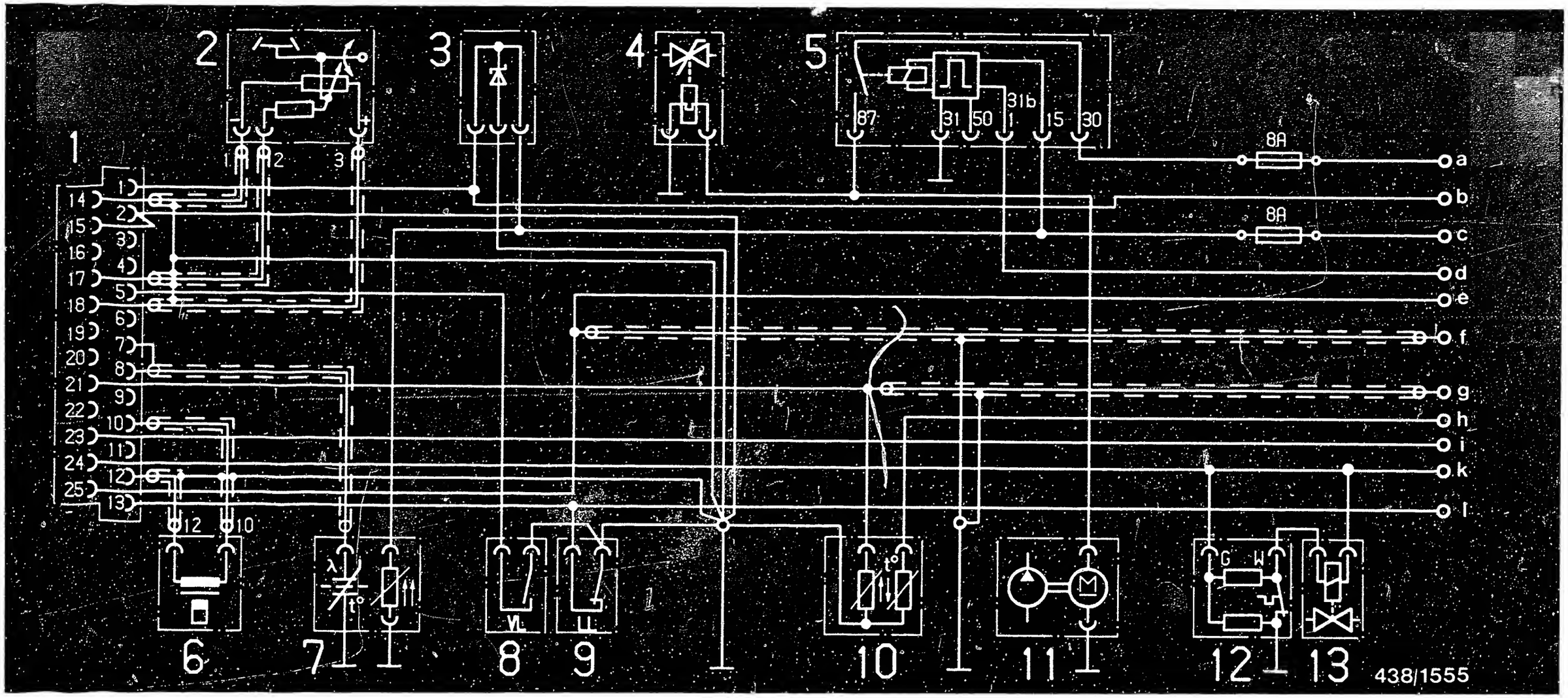
No.	Switch/Btn V	Ω	Btn	Under test	Test connections	Test conditions	Test specifications
6	5	—	–	TD signal, ignition	25 – 2	Control-unit lead plug disconnected. Actuate starting motor for a few seconds:	Voltage undefined
7	6	–	–	Control-unit supply	1 – 2	Control-unit lead plug disconnected. Switch on ignition.	8...15 V
8	7	–	–	Supply, air-flow sensor potentiometer	18 – 2	Connect control unit. Switch on ignition.	7...8 V
9	8	–	–	Signal, air-flow sensor potentiometer	17 – 2	Control unit connected. Switch on ignition. Air-flow sensor plate in neutral position: Deflect air-flow sensor plate by hand, continuous voltage rise up to max.:	 approx. 0 V 8 V
10	14	24	–	Lambda closed-loop control, closed-loop control function	23 – 2	Control unit connected. Bridge sockets 1 and 2 at test adapter. Engine at normal operating temperature, idle. Closed-loop control function: oscillating voltage reading. Mean value:	 approx. 3 V
11	–	–	1	Warm-up enrichment -20°C	12 – 12	Current measurement! Measuring-instrument connection: Negative = black socket 1 Positive = black socket 2 Control unit connected. Switch on ignition.	 47...67 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Switch/Btn Ω	Switch/Btn Btn	Under test	Test connections	Test conditions	Test specifications
12	–	–	2	Actuator current Engine at norm. op. temp.	12 – 12	Control unit connected. Switch on ignition.	9... 11 mA
13	–	–	2 /4	Starting enrichment	12 – 12	Control unit connected. Switch on ignition. Keep push-button 2 pressed. Actuation of starting enrichment (temperature-independent) when starting cranking (btn 4): Regulation time approx. 1 s.	130...150 mA
14	–	–	1 /4	Post-start enrichment	12 – 12	Control unit connected. Switch on ignition. Keep push-button 1 pressed: Press push-button 4. Current rise to: After short pause, regulation to: Regulation time approx. 90 s.	47... 65 mA 130...150 mA 47... 67 mA
15	–	–	1 /6	Acceleration enrichment	12 – 12	Control unit connected. Switch on ignition. Keep push-buttons 1 and 6 pressed. Current value: Quickly deflect air-flow sensor plate. Current rise to: Regulation approx. 1 s to:	47... 67 mA 75...115 mA 47... 67 mA
16	–	–	2	Overrun cut-off	12 – 12	Control unit connected. Re-connect ammeter (swap positive and negative). Start engine. Speed n to approx.: Hold there. While push-button 2 pressed, actuate throttle-valve switch, idle. Engine hunts. Current reading during falling speed phase:	1800 min $^{-1}$ -40...-80 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test connections	Test conditions	Test specifications
17	–	–	–	Engine–speed limitation	12 – 12	Operation through current reversion as with overrun cut–off. Cut–out speed:	 6300...6500 min $^{-1}$
18	–	–	–	Full–load enrichment	12 – 12	Control unit connected. Start engine. Manually actuate throttle–valve switch, full load (at throttle–valve assembly, at front). Speed range up to approx. 3000 min $^{-1}$, current rise by: Speed range as of approx. 3800 min $^{-1}$, further current rise by:	 1... 3 mA 2... 4 mA
19	–	24	–	Lambda closed–loop control, closed–loop control operation	12 – 12	Control unit connected. Engine at norm. op. temp., idle. Closed–loop control mode can be recognized from the oscillating current reading. Mean value: If mean value outside tolerance, set (idle–mixture–adjusting screw) to:	 4...16 mA 9...11 mA
20	–	22	–	Lambda closed–loop control, rich stop	12 – 12	Control unit connected. Switch on ignition. Current rise to:	 18...22 mA
21	–	23	–	Lambda closed–loop control, lean stop	12 – 12	Control unit connected. Switch on ignition. Current drop to:	 0... 2 mA

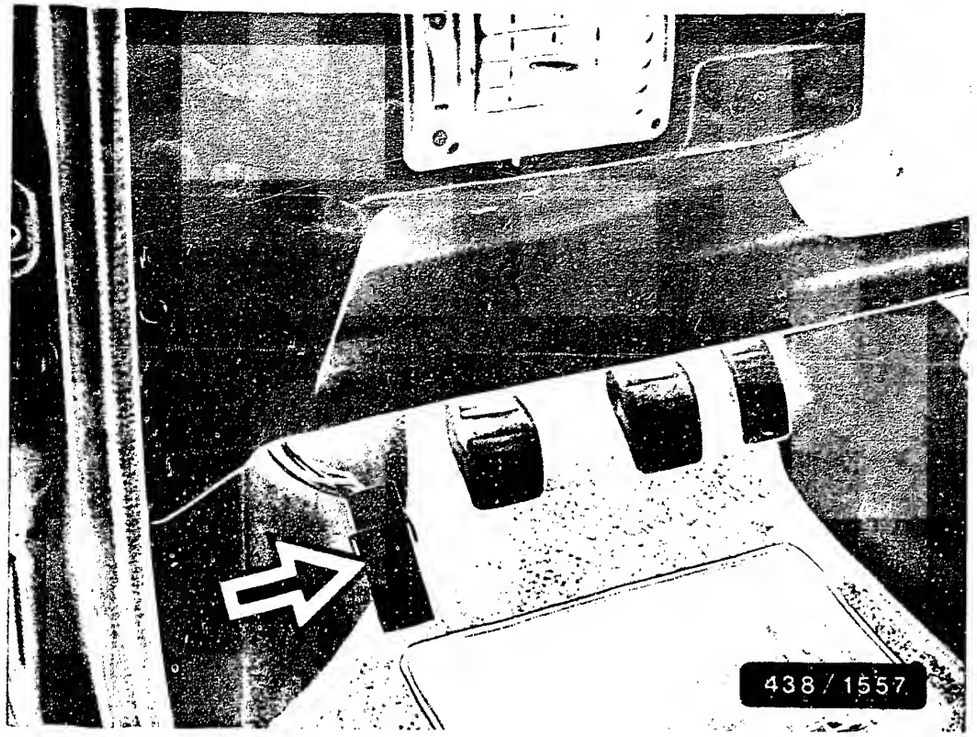


ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT

1 = Control unit, KE-Jetronic
2 = Air-flow sensor potentiometer
3 = Over-voltage protection relay
4 = Auxiliary-air device
5 = Electronic speed relay
6 = Electro-hydraulic pressure actuator
7 = Heated lambda sensor
8 = Throttle-valve switch, full load
9 = Throttle-valve switch, idle
10 = Temperature sensor, engine (Double NTC)
11 = Electric fuel pump
12 = Thermo-time switch
13 = Cold-start valve
a = Terminal 30
b = Ignition coil, term. 1
c = Diagnosis plug, term. 5
d = Ignition control unit, term. 6
e = Ignition control unit, term. 5
f = Ignition control unit, term. 17 (TD signal)
g = Terminal 15 (after fuse)
h = Diagnosis plug, term. 4 (Lambda signal)
i = Ignition control unit, term. 5
k = Ignition lock, term. 50
l = Diagnosis plug, term. 2

G19 — ⟹

G20 — ⟸



Arrow = Relay for electric fuel pump

BRIDGING SAFETY CIRCUIT

The electronic speed relay for actuation of the electric fuel pump is positioned beneath the instrument panel on the driver's side.

To bridge, remove relay from holder and disconnect from relay base.

BRIDGING SAFETY CIRCUIT (CONTINUED)

Connect connections 30 and 87 with an auxiliary cable (1.5 mm ^{2} cross-section with fuse element).

I m p o r t a n t :
Operation of the electric fuel pump is required for pressure measurements. For electrical testing, switch on only the ignition.

C a r e f u l :

Never deflect (lift) the sensor plate when the electric fuel pump is running, as this would cause fuel to be injected. Subsequent operation of the starting motor could lead to extremely serious engine damage.

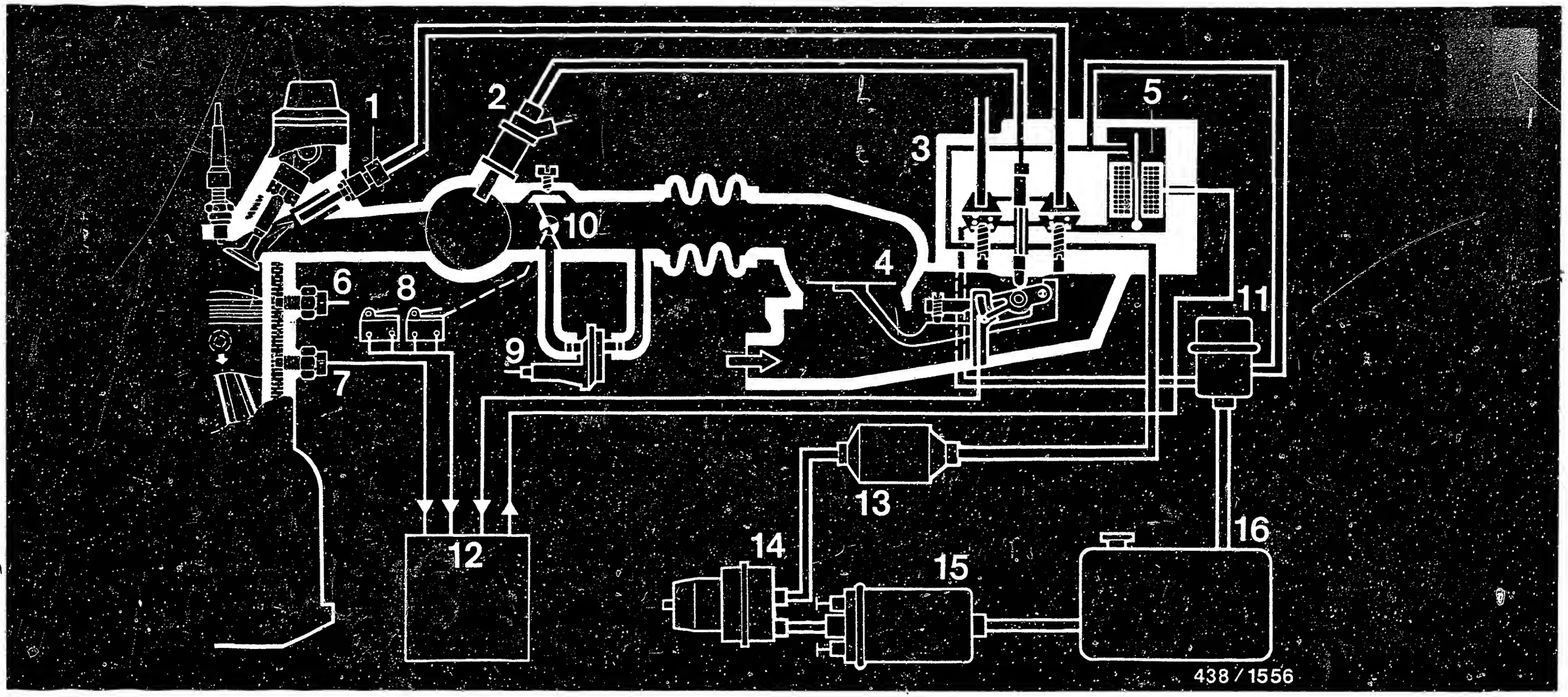


DIAGRAM OF AIR AND FUEL LINES

1 = Injection valve(s)
2 = Cold-start valve
3 = Fuel distributor
4 = Air-flow sensor
5 = Electro-hydraulic pressure actuator
6 = Thermo-time switch
7 = Temperature sensor, engine (Double NTC)
8 = Throttle-valve switch, idle/full load
9 = Auxiliary-air device
10 = Throttle valve
11 = Pressure regulator (primary pressure)
12 = Control unit, KE-Jetronic
13 = Fuel filter
14 = Fuel accumulator
15 = Electric fuel pump
16 = Fuel tank

INSTALLATION POSITION OF COMPONENTS

* Mixture-control unit: on the air-filter casing, in area of left, interior wheel house.

* Fuel filter: beneath mixture-control unit.

* Fuel accumulator: at left, interior wheel house, next to brake booster.

* Throttle-valve switch:
At throttle-valve assembly, front. Idle switch bottom full-load switch top.

* Cold-start valve: in intake manifold, in area of throttle-valve assembly mounting flange.

* Auxiliary-air device:
Beneath throttle-valve assembly mounting flange.

* Injection valves:
In the flanges of the intake tubes.

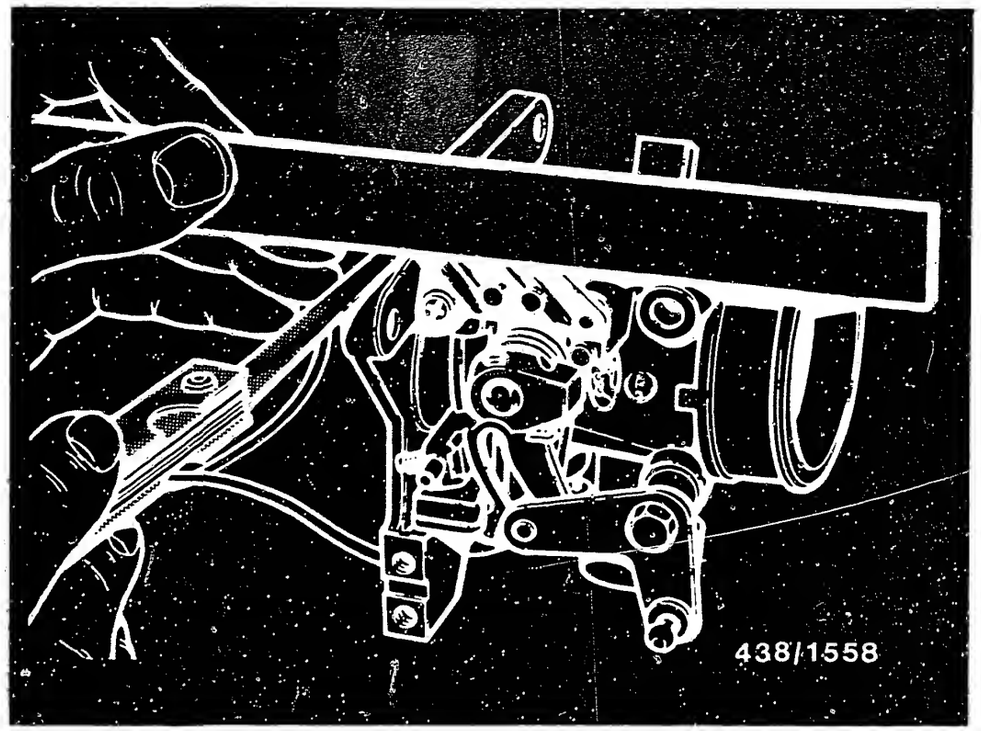
* Lambda sensor: front side of engine, in exhaust pipe, in area of starting motor.

* Control unit, KE-Jetronic: the control units for ignition and KE-Jetronic are positioned at the engine firewall behind the heater housing (identical casings). The KE control unit is positioned on the right (referring to forward direction of travel).

* Thermo-time switch, temperature sensor: rear side of engine, in area above oil filter.

* Over-voltage protection relay: in the central electrics marked with "KE".

* Electric fuel pump: underside of vehicle in area above rear axle. A fuel-line-pressure damper is positioned at pressure-side connection (noise damping).



NOTES ON REMOVAL AND INSTALLATION OF THROTTLE-VALVE SWITCH, IDLE/FULL LOAD

Due to the common plug connection, the two throttle-valve switches can only be exchanged as a pair.

Idle switch: Set so that the switch closes when the throttle valve is closed and opens immediately after leaving the throttle-valve closed position.

Full-load switch: Before removing, position straight-edge at switch upper edge and measure clearance between straightedge and throttle-valve assembly mounting flange using feeler gauge (illustration).

Adjust new switch to measured dimension. Make certain that the switch closes when the throttle-plate lever reaches full-load position.

GENERAL IMPORTANT INFORMATION

* When testing with the electric fuel pump running, never deflect (lift) the air-flow sensor plate of the air-flow sensor, because fuel is then injected. This may lead to very serious engine damage when the engine is started afterwards.

* When testing the injection valves using the valve tester, observe the test-device specifications. Never test using automobile gasoline or other highly inflammable fluids.
Even when using white spirit, observe the workplace safety regulations.

* Leakage test of engine intake system using only permissible leakage protection spray (e.g. Gypoflex). Do not use any highly inflammable fluids. Observe workplace safety regulations.

* Never start engine when battery is not firmly connected and never disconnect the battery from the vehicle electrical system when the engine is running.

* When fast charging, disconnect the battery from the vehicle electrical system.

* At temperatures above 80°C (e.g. drying oven), electronic control units must be removed, this also being the case when electrically welding (e.g. spot welding).

* Make sure that all wiring-harness plugs are seated perfectly.

* Never disconnect or connect lead plugs of electronic control units when the ignition is switched on.

For production reasons: continued on the following coordinate.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : OPE-518

BOSCH System : LU2 - Jetronic

Vehicle make : Opel

Basic microcard : OPE-512

SPECIAL FEATURES

This microcard contains the LU-Jetronic trouble-shooting instructions for the following Opel models valid at the time of writing:

Senator, Monza with 3.0 l/ 6 cyl. engine from 08.85.

* LU2-Jetronic with 25-pin control unit 0 280 001 312/313, triggered by term. 5 of the ignition control unit, 5-pin air-flow sensor and 7-pin control relay.
* Solenoid-operated fuel-injection valves with brass wire coil.
* Start control, i.e. additional injection quantity through all fuel-injection valves.
* Instead of auxiliary-air device: idle actuator and idle-speed controller (control-unit) of the low-idle-speed control.
* Double NTC for Jetronic and low-idle-speed control.
* Heated lambda sensor for lambda closed-loop control and three-way catalytic converter

Note:

The LU2-Jetronic in the Opel 3.0 1/6 cylinder engine essentially corresponds to that of the Opel 1.8 1/4 cylinder.

* Similar SIS repair instructions: SIS microcard OPE-512.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

* Universal test adapter 0 684 101 801 and
* Adapter cable 1 684 463 123 and 1 684 463 137

The following rapid diagnosis chart makes it possible for the experienced L-Jetronic specialist to rapidly test the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

* Test-step sequence
* Position of the V- and Ω -program switch
* Remarks on the operation of the universal test adapter and other components
* Test specifications for motortester and multimeter

Rapid diagnosis chart for universal test adapter

Testing the LU2-Jetronic with adapter cable 1 684 463 123

Test step	Switch position V	Switch position Ω	Measurement	Control-unit plug between terminals	Remarks	Test specifications (reading)
1	5	–	t_D signal from ignition control unit term. 5	1 and 5	Disengage gear and start	Rectangular pulse on oscilloscope
2	6	–	Voltage from control relay term. 87	9 and 5	Disengage gear and start	8...15 V
3	7	–	Voltage from ignition and starting switch term. 50	4 and 5	Disengage gear and start	8...15 V
4	| V	11	Combined resistance in air-flow sensor term. 8	8 and 5	———	100...200 Ω
5	| V	12	Resistance of potentiometer in air-flow sensor term. 7	7 and 5	Deflect sensor flap all the way to stop	60...1000 Ω
6	| V	13	Resistance of double temperature sensor NTC II term. 10 (engine temperature)	10 and 5	——— +15°C...+30°C :	1,45...3,3 k Ω
					+80°C :	280...360 Ω
7	| V	14	Resistance of ground output stage term. 13	13 and 5	———	0...10 Ω
8	| V	15	Resistance of ground output stage term. 25	25 and 5	———	0...10 Ω

H03 — ⟹

H04 — ⟺

Rapid diagnosis chart for universal test adapter (continued)

Testing the LU2-Jetronic with adapter cable 1 684 463 123

Test step	Switch position V	Switch position Ω	Measurement	Control-unit plug between terminals	Remarks	Test specifications (reading)
9	|	16	Resistance of idle contact in throttle-valve switch term. 2	2 and 9	Pull plug connector from ignition control unit. Accelerator pedal at rest	0...10 Ω
					Slightly depress accelerator pedal	infinite Ω
10	|	17	Resistance of full-load contact in throttle-valve switch term. 3	3 and 9	Accelerator pedal at rest	infinite Ω
					Fully depress accelerator pedal (full-load position)	0...10 Ω
11	|	18	Resistance of 3 parallel-connected solenoid-operated fuel-injection valves term. 12 (group I)	12 and 9	Re-connect ignition control-unit plug connection + 20° C : + 80° C :	 8,2...10,9 Ω 8,7...11,7 Ω
12	|	19	Resistance of 3 parallel-connected solenoid-operated fuel-injection valves term. 24 (group II)	24 and 9	——— + 20° C : + 80° C :	8,2...10,9 Ω 8,7...11,7 Ω

Rapid diagnosis chart for universal test adapter

Testing low-idle-speed control with adapter cable 1 684 463 137

Test step	Switch position V	Switch position Ω	Measurement	Control-unit plug between terminals	Remarks	Test specifications (reading)
1	5	–	Voltage pulse from ignition coil term. 1	12 and 2	Idle-speed control (CU) not connected. Disengage gear and start.	Ignition pulse on oscilloscope
2	6	–	Voltage from control relay term.87b	1 and 2	Disengage gear and start.	8...15 V
3	7	–	Voltage through throttle-valve idle contact terms. 2 and 18	8 and 2	Idle-speed control (CU) connected. Disengage gear and start. Accelerator pedal at rest.	8...15 V
					Slightly depress accelerator pedal.	approx. 0 V
4	V	14	Resistance of double temperature sensor NTC II term. 67 (engine temperature)	9 and 2	+15°C...+30°C :	1,45...3,3 k Ω
					+80°C :	280...360 Ω
5	V	20	Resistance of idle actuator terms. 1 and 2	3 and 4	— +15°C...+30°C :	20...32 Ω
					+80°C :	24,5...37 Ω
6	V	21	Resistance of idle actuator terms. 3 and 2	5 and 4	— +15°C...+30°C :	18...29,5 Ω
					+80°C :	22...34 Ω
7	V	21	On-off ratio at idle speed Manual trans. : 770...830 min^{-1} Automatic : 30...34 min^{-1}	5 and 4	Connect dwell-angle tester to black test sockets 1 and 2 on universal test adapter. Engine at normal operating temperature : Accelerator pedal at rest :	 670...730 % 27...31 %

TEST SPECIFICATIONS

Pressure regulator

* Fuel pressure:	2,8...3,2 bar

Electric fuel pump

* Delivery quantity in return line:	min. 850 cm ^{3} /30 s
* Connection voltage at load:	min. 12 V

Temp. sensor NTC II (engine)

Double NTC for LU2-Jetronic and low-idle-speed control

* Electrical internal resistance of each temperature sensor:	
At ambient temperature (+15°C...+30°C):	1,45...3,3 k Ω
With engine at operating temperature (approx. +80°C):	280...360 Ω

Lambda sensor heating

* Electrical internal resistance (PTC)	1,0...15 Ω

Air-flow sensor

* Resistance between:	
Terms.8 and 5:	340... 450 Ω
Terms.7 and 5:	
(fully deflect sensor flap)	60...1000 Ω
Terms.9 and 5:	500... 760 Ω
Terms.8 and 9:	160... 300 Ω

Start control with NTC II connection plug pulled

Connect ignition lead term.4 to ground via 5 k Ω sleeve-type suppressor and spark gap.

* Connection voltage at one solenoid-operated fuel injection valve: drops from initially more than 2,5 V within approx. 15 s starting time to approx. 0,3 V.

Test specifications (continued)

Solenoid-operated fuel-inj. valve

* Electrical internal resistance at + 20° C:	15,0...17,5 Ω

Idle actuator

* Electrical internal resistance of each winding	
Terms.3 to 4 +15°C...+30°C:	19,0...25,0 Ω
+80°C:	23,5...30,0 Ω
Terms.5 to 4 +15°C...+30°C:	17,0...22,5 Ω
+80°C:	21,0...27,0 Ω

Idle setting

Engine at normal operating temperature (approx. +80°C).

* Idle speed:	
Manual transmission:	770...830 min $^{-1}$
at on-off ratio:	30... 34 %
Automatic transmission:	670...730 min $^{-1}$
at on-off ratio:	27... 31 %
* CO setting via lambda closed-loop control Closed-loop control operation (sensor conn.), integrator voltage at test pin (term. 22)	Voltage reading oscillates between 2 values
Open-loop control (sensor lead separated):	Voltage reading must be identical with the oscillating mean value

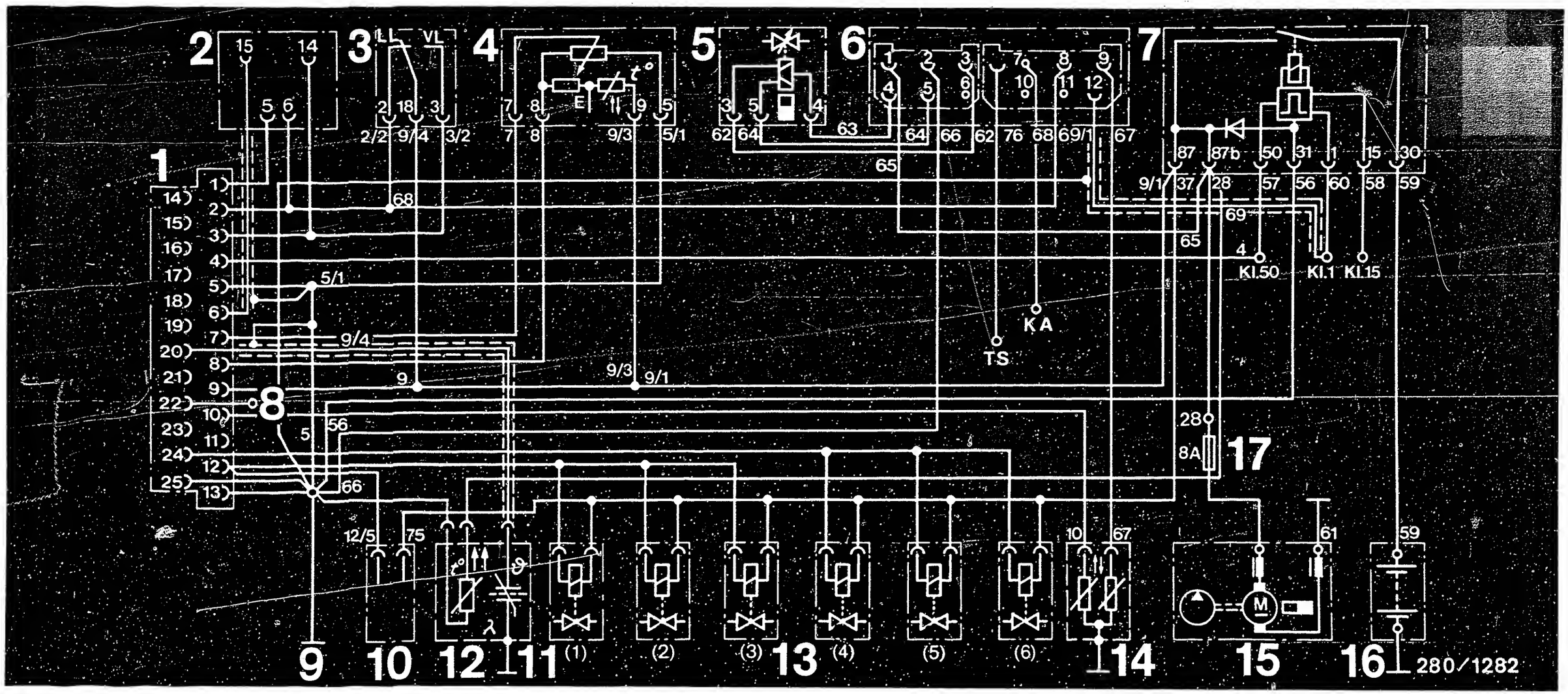
Lambda closed-loop control

* Rich value (disconnect sensor lead and connect to ground on control-unit side):	10...12 V
* Lean value (apply 2 V to the sensor lead on control-unit side):	approx. 0,5 V

Switch off the extractor unit while exhaust-gas measurement and adjustment are being carried out.

For adjusting values for ignition, valve clearance, and other engine technical data, see equipment and Autodata microcards.

For production reasons:
continued on the following coordinate.

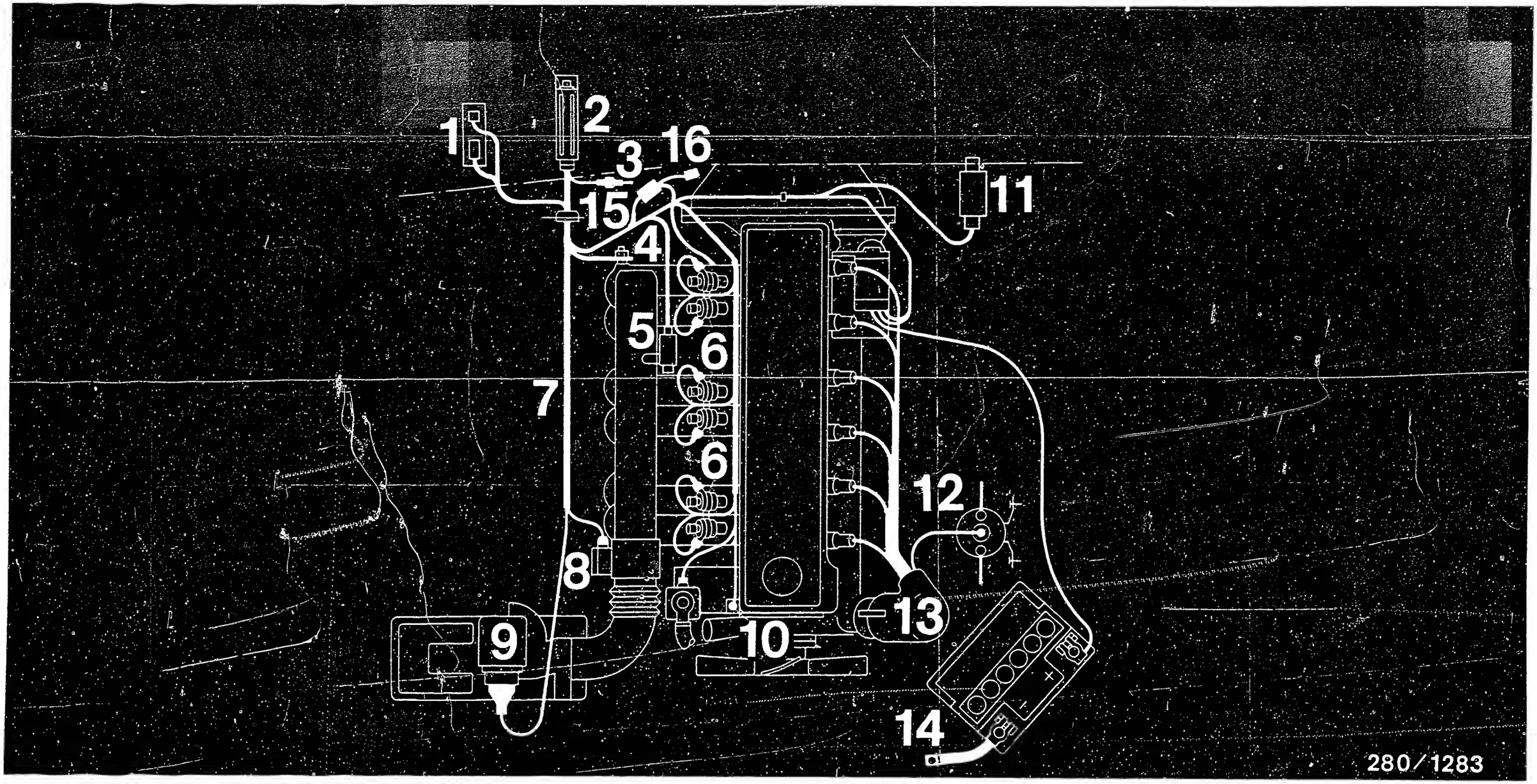


ELECTRICAL TERMINAL DIAGRAM

1 = Multiple-pin plug to control unit
2 = Ignition-control unit
3 = Throttle-valve switch
4 = Air-flow sensor
5 = Idle actuator
6 = Low-idle-speed control (control unit)
7 = Control relay
8 = Test pin (integrator voltage, lambda closed-loop control)
9 = Central ground, output stages and electronics
10 = On-board computer
11 = Heated lambda sensor
12 = 3-pin plug connection for heated lambda sensor
13 = Solenoid-operated fuel-injection valves
14 = Double temperature sensor (engine temperature NTC II)
15 = Electric fuel pump
16 = Battery
17 = Pump fuse

KA = Air conditioning
TS = Temperature switch

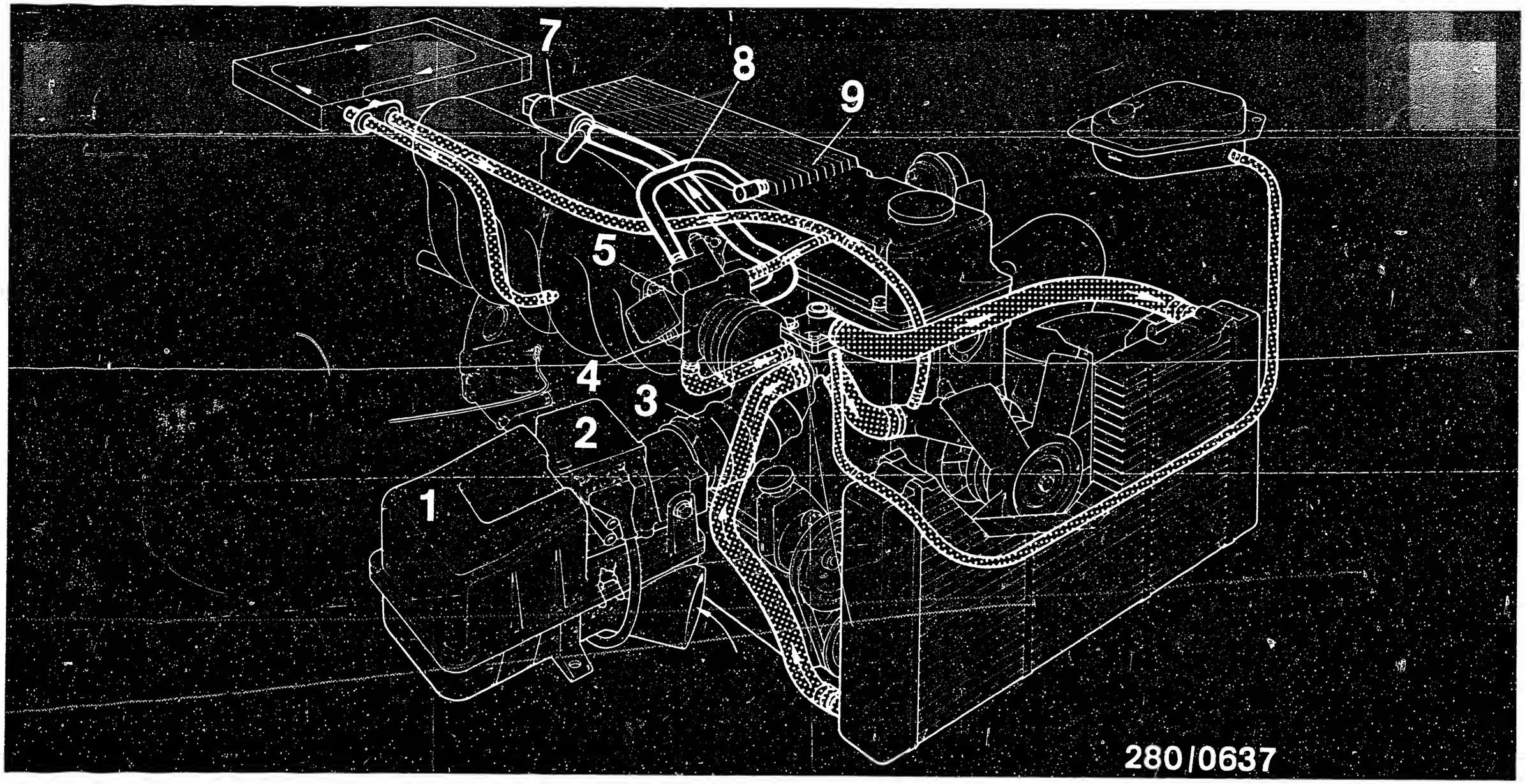
H13 ⟹ | H14 ⟸



ELECTRICAL WIRING DIAGRAM AND ARRANGEMENT OF INDIVIDUAL COMPONENTS

1 = Low-idle-speed control
2 = Control unit
3 = Plug connection term. 1
4 = Central ground
5 = Idle actuator
6 = Solenoid-operated fuel-injection valves
7 = Jetronic wiring harness
8 = Throttle-valve switch
9 = Air-flow sensor
10 = Double temperature sensor (engine temperature NTC II)
11 = Control relay
12 = Ignition coil
13 = Ignition distributor
14 = Battery
15 = 3-pin plug connection for heated lambda sensor
16 = Test pin (integrator voltage)

H15 ⟹ | H16 ⟸



AIR-LINE DIAGRAM

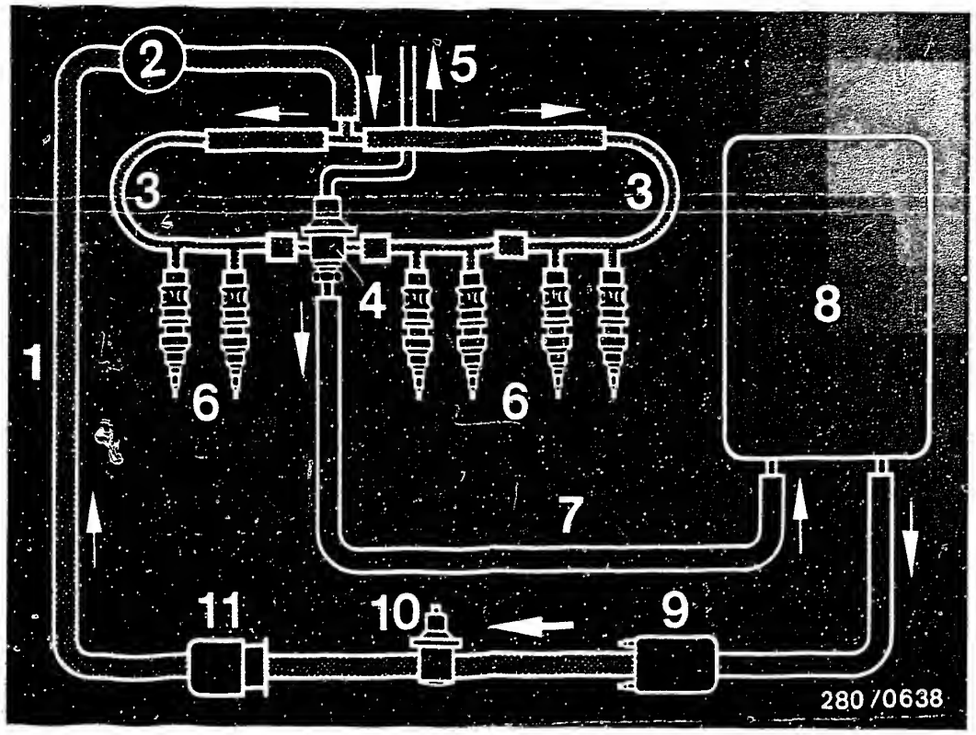
= Air hose lines

= Water hose lines

1 = Air filter
2 = Air-flow sensor
3 = Air guide hose
4 = Intake-manifold heating
5 = Throttle-valve assembly
6 = Intake manifold
7 = Idle actuator
8 = Crankcase ventilation
9 = Valve cover

H17 ⟹

H18 ⟸



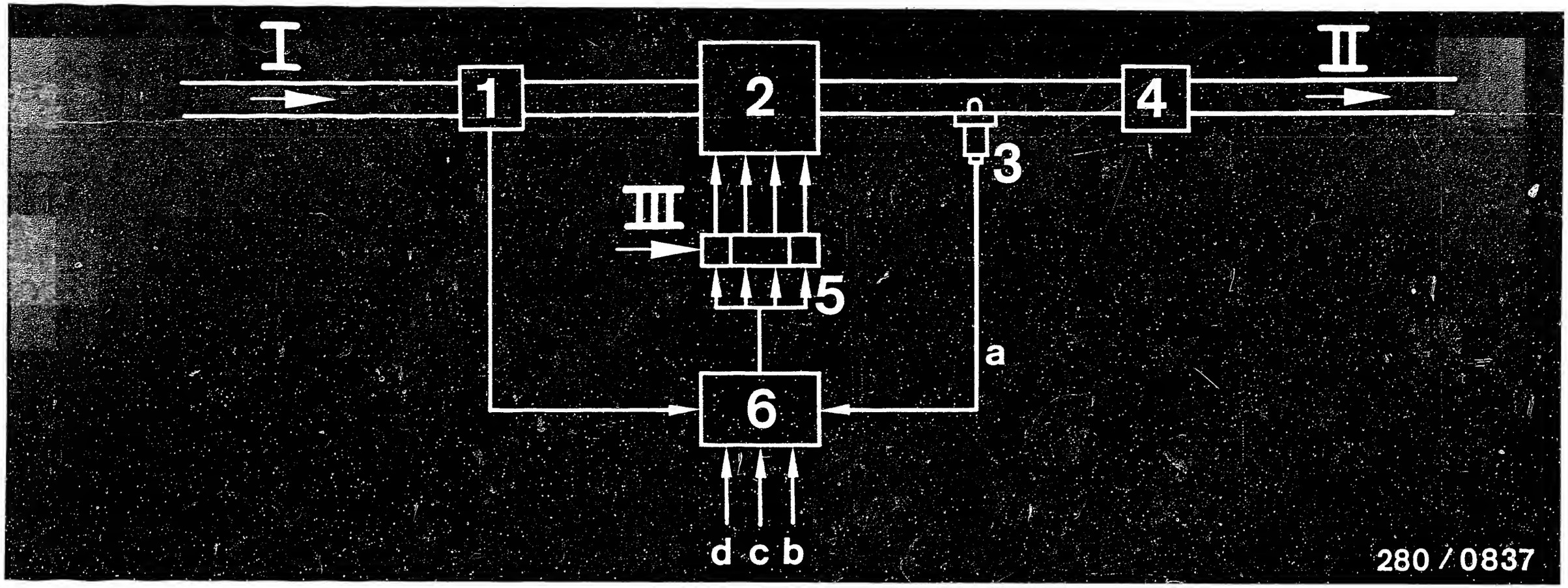
FUEL-LINE DIAGRAM

For production reasons:
continued on the following
coordinate.

——————— = Pressureless

——————— = Fuel pressure

1 = Fuel-injection tubing
2 = Damper unit
3 = Ring fuel main
4 = Pressure regulator
5 = Intake-manifold pressure connection
6 = Solenoid-operated fuel-injection valves
7 = Return line
8 = Fuel tank
9 = Electric fuel pump
10 = Pressure damper
11 = Fuel filter



1 = Air-flow sensor
2 = Engine
3 = Lambda sensor
4 = 3-way catalytic converter
5 = Solenoid-operated fuel-injection valves
6 = LU control unit with lambda closed-loop control

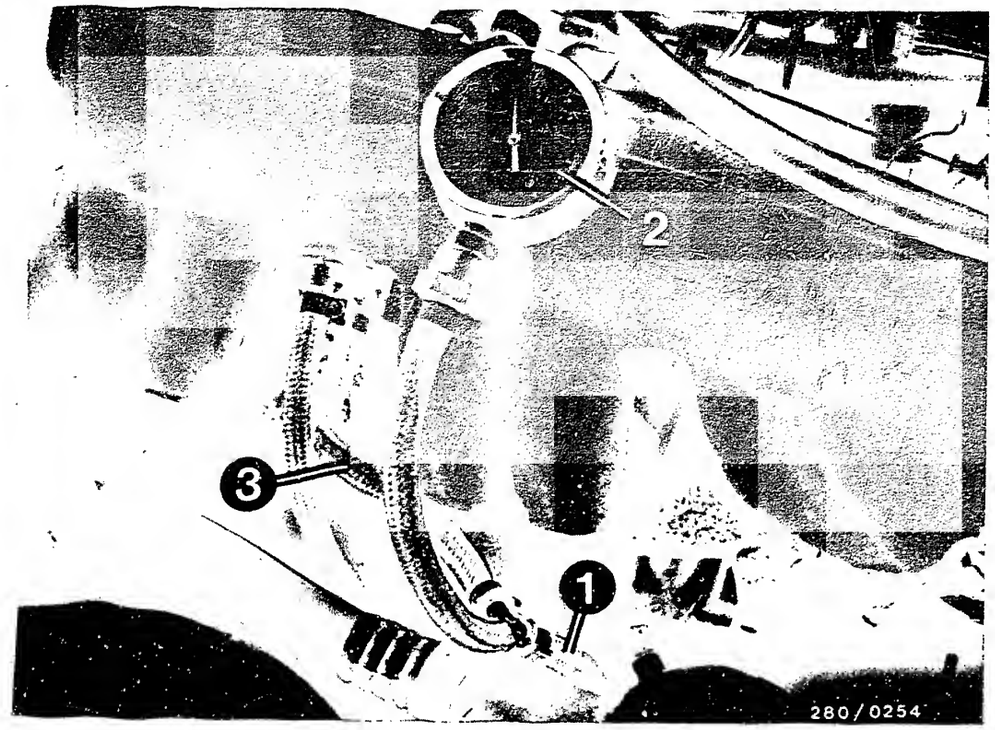
a = Sensor voltage
b = Supply voltage
c = Engine speed
d = Engine temperature

I = Air
II = Exhaust
III = Fuel

OPERATION OF LAMBDA CLOSED-LOOP CONTROL

The control loop, closed with the help of a special sensor - the lambda sensor - allows deviations from a certain air-fuel ratio to be recognized and corrected. The closed-loop control principle is based on continuous monitoring of the residual oxygen content of the exhaust by the lambda sensor. This provides a measurement for the composition of the air-fuel mixture provided to the engine. The lambda sensor in the exhaust pipe supplies information on whether the mixture is richer or leaner than lambda = 1. This deviation is supplied to the control unit and the lambda control (in the control unit) influences the injection duration or quantity pre-calculated by the fuel-injection control. This regulation to lambda = 1 is the essential prerequisite for a high rate of effectiveness of pollutant combustion in the 3-way catalytic converter.

H21 ⟹ | H22 ⟸



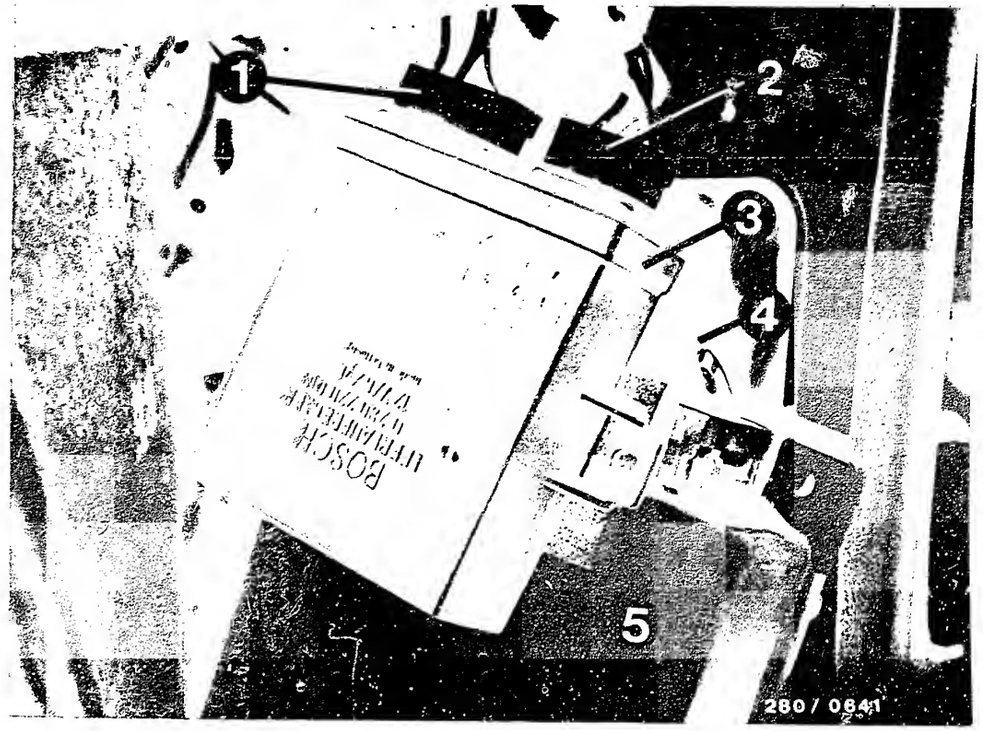
1 = To connection port (pressure side)
2 = Pressure gauge
3 = Fuel delivery line

FUEL-PRESSURE TEST

Use the pressure gauge and hose line of pressure-testing device KDJE-P 100 or 1 687 231 154 for pressure testing.

Connect 3-way line KDJE-P 100/13 between the fuel-distribution pipe and the fuel-injection tubing.

Important:
Make sure that no fuel gets on hot engine parts.

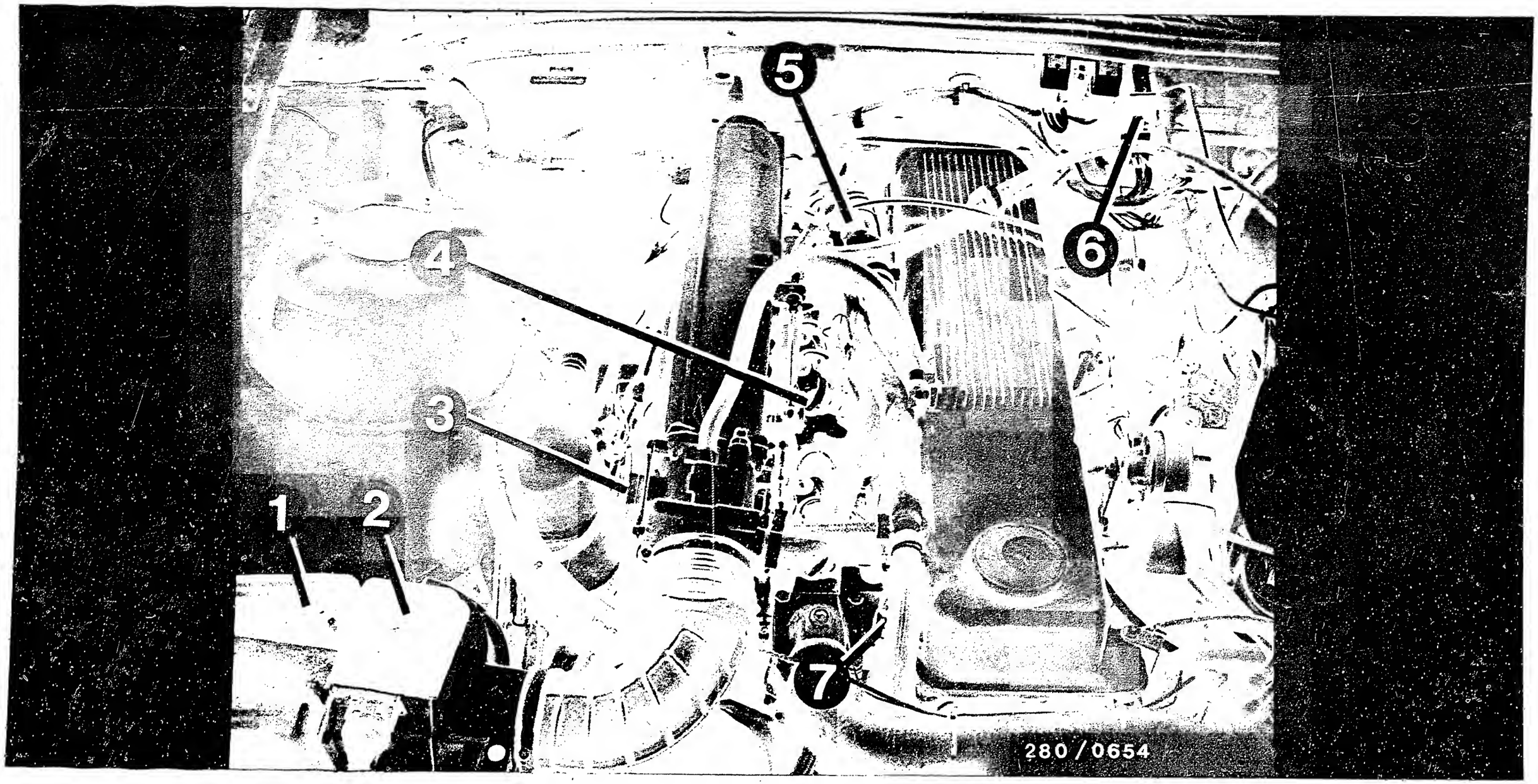


LU2 Jetronic low-idle-speed control
1 = 8-pin plug
2 = 6-pin plug
3 = Low-idle-speed control (control unit)
4 = 25-pin control-unit plug
5 = Control unit

INSTALLATION POSITION OF COMPONENTS

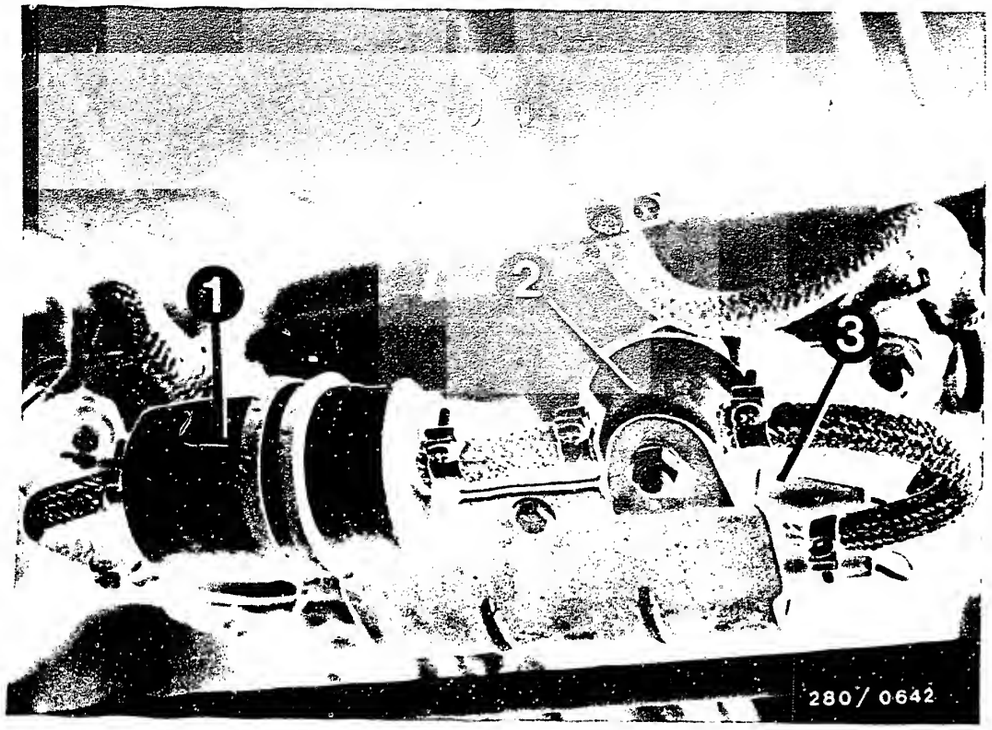
* Control units in passenger compartment. All position information is with reference to the direction of travel.

Both control units are located one above the other in the footwell on the passenger's side on the lower right:
LU2-Jetronic - Connect the universal test adapter to the control-unit plug using the 25-pin adapter cable.
Low-idle-speed control - plug in the universal test adapter with the 6/8-pin adapter cable between the two plugs and low-idle-speed control (control unit).



* Arrangement of components on engine

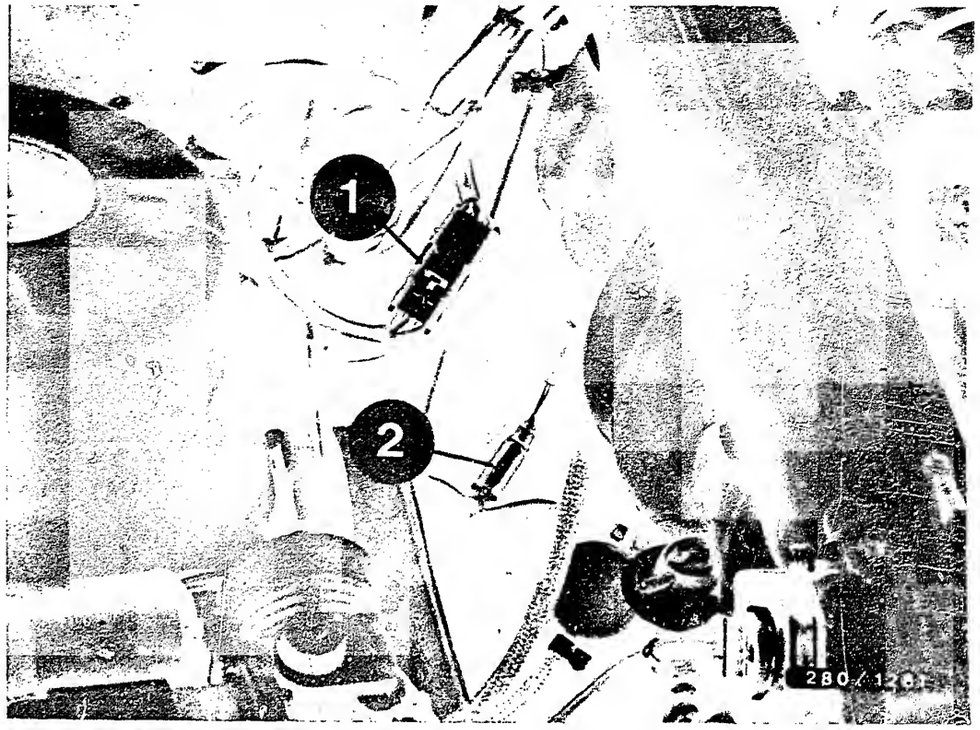
1 = Air filter
2 = Air-flow sensor
3 = Throttle-valve switch
4 = Fuel-injection valves
5 = Idle actuator
6 = Control relay
7 = Double temperature sensor
(engine temperature NTC II)



1 = Fuel filter
2 = Pressure damper
3 = Electric fuel pump; protected from contamination by mounting plate (partly covered in illustration)

* Fuel-supply system components

All three components are located on the bottom of the vehicle to the right of the fuel tank.



1 = 3-pin plug connection for heated lambda sensor
2 = Lambda sensor

The test pin (term. 22) for measuring integrator voltage is located in the engine compartment (firewall).

* Central ground

The electronics and output-stage ground are combined on the intake tube of cylinder 6.

* Pressure regulator

On the ring fuel main between the intake tubes of cylinders 2 and 5.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : POR-511

BOSCH System : Motronic

Vehicle make : Porsche

Basic microcard : POR-507

New microcard.

* PORSCHE 944 Turbo as of 7.85 with Motronic. 2.5 1/4 cyl. engine with/without lambda closed-loop control.

Countries of application: world-wide

SPECIAL FEATURES:

* Idle mixture control
* Knock and charge-air-pressure control

The Motronic works in conjunction with the knock and charge-air-pressure control built into this vehicle. A separate microcard has been made up for the knock control and charge-air-pressure control. Versions for different countries wired via term. 10 and term. 30.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

The following rapid diagnosis chart makes it possible for the experienced Motronic specialist to rapidly test the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

* Test-step sequence.
* Position of the V- and Ω -program switch.
* Remarks on operating the universal test adapter or other components.
* Test specifications for motortester and multimeter.

Note:

* Adapter cable 1 684 463 124 for vehicles without lambda closed-loop control.
* Adapter cable 1 684 463 128 for vehicles with lambda closed-loop control.

Adapter cable 1 684 463 124 can also be used for vehicles with lambda closed-loop control by way of replacement; however, the lambda test steps must be carried out in addition (see test steps POR-507, 45a, and 46a).

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPATER

Applies to the control units 0 261 200 053 (USA with lambda closed-loop control)
0 261 200 054 (without lambda closed-loop control)
0 261 200 075 (world-wide).

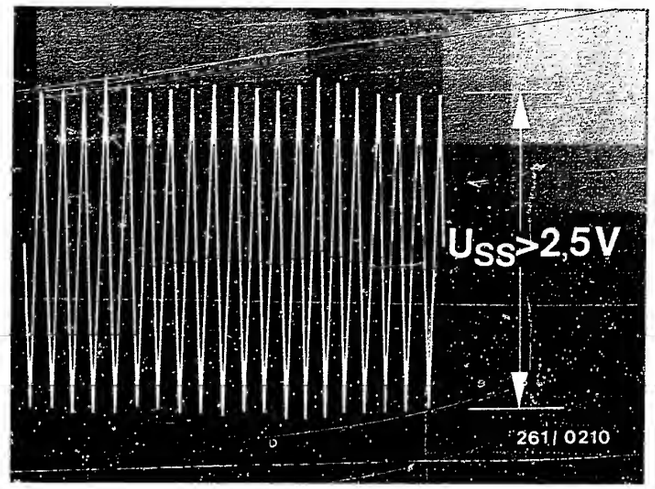
Test step	Switch position V	Switch position Ω	Measurement	Control-unit plug between terminals:	Remarks	Test specifications (reading)
1	V	1	Insulation resistance of the engine-speed sensor	8 and 5	Disengage gear. Ignition off. Unplug control unit and pump fuse no. 34	more than 1 M Ω
2	V	2	Insulation resistance of reference-mark sensor	25 and 5	—	more than 1 M Ω
3	V	3	Winding resistance of engine-speed sensor	8 and 27	—	0.6...1.6 k Ω
4	V	4	Winding resistance of reference-mark sensor	25 and 26	—	0.6...1.6 k Ω
5	V	5	Resistance of engine-temperature sensor (NTC II)	13 and 5	Resistance dependent on temperature: (+ 15° C...+ 30° C) : (+ 80° C) :	 1.45...3.3 k Ω 280 ...360 Ω
6	V	6	Resistance of air-temperature sensor (NTC I)	22 and 5	Resistance dependent on temperature: (+ 15° C...+ 30° C) : (+ 80° C) :	 1.45...3.3 k Ω 280...360 Ω
7	V	7	Resistance of characteristic-map switch	10 and 5	For Sweden/Switz./US/California : For US Fed. and world-wide :	less than 10 Ω more than 1 M Ω
8	V	8	Not applicable	—	—	—
9	V	9	Throttle-valve sensor Resistance of idle contact	2 and 5	Accelerator pedal at rest : Open throttle valve slightly :	less than 10 Ω more than 1 M Ω
10	V	10	Full-load enrichment via knock-control unit Resistance of knock-control unit	3 and 5	Resistance dependent on polarity. Positive at right jack : Reversed polarity :	 1...9 Ω more than 100k Ω

J03 — <⟹>

J04 — <⟹>

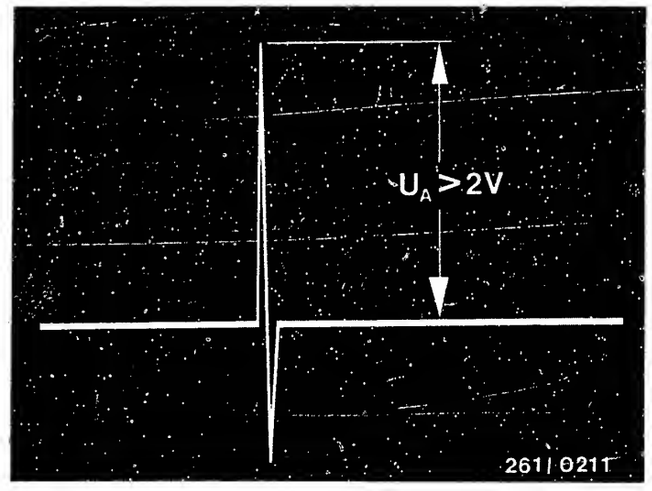
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Control-unit plug between terminals:	Test specifications (reading)
11	| V	11	Resistance of ground lead.	16 and 5	less than 10 Ω
12	| V	12	Resistance of ground lead.	17 and 5	less than 10 Ω
13	| V	13	Resistance of ground lead.	19 and 5	less than 10 Ω
14	| V	14	Resistance at input for altitude correction. Vehicles without lambda closed-loop control: Vehicles with lambda closed-loop control or with control unit 0 261 200 054: US with altitude sensor, switch open (below 1,000 m altitude): US with altitude sensor, switch closed (above 1,000 m altitude):	30 and 5	 1.6...2 Ω more than 1 M Ω more than 1 M Ω less than 10 Ω
15	| V	15	Resistance of driving-position selector switch.	28 and 5	less than 10 Ω
16	1	15	Engine-speed sensor signal with oscilloscope. Disengage gear and start.	8 and 27	See upper illustration
17	2	15	Reference-mark sensor signal with oscilloscope. Disengage gear and start.	25 and 26	See lower illustration



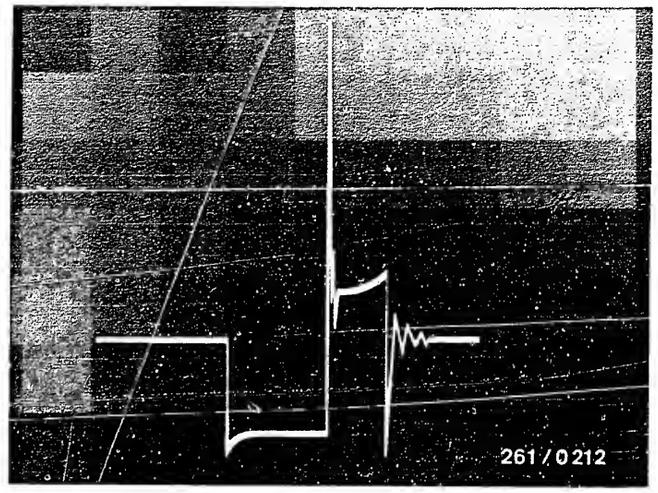
Engine-speed sensor signal

Reference-mark sensor signal



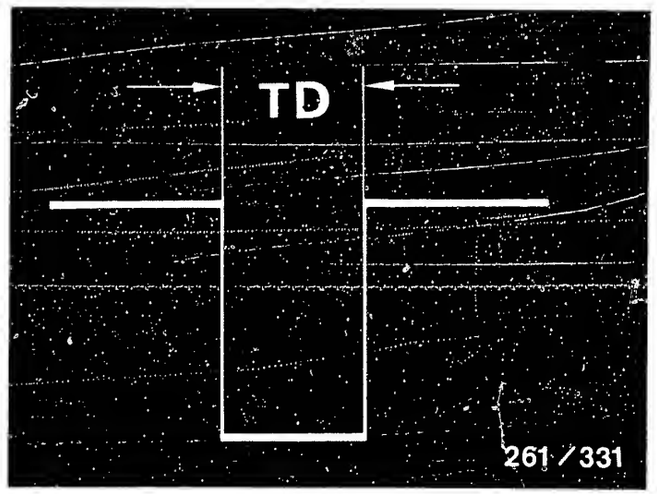
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Control-unit plug between terminals:	Test specifications (reading)
18	3	15	Not applicable	10 and 5	——
19	4	15	Air-conditioner voltage. Switch on air conditioner.	29 and 5	more than 8 V
20	6	15	Voltage of main relay. Ignition on.	35 and 5	10...15 V
21	7	15	Voltage of main relay. Ignition on.	18 and 5	10...15 V
22	5	15	Ignition signal from ignition coil with oscilloscope. Ignition off. Connect control unit. Disengage gear and start.	1 and 5	Signal present. (See upper illustration)
23	8	15	Supply voltage for air-flow sensor. Ignition on.	9 and 5	more than 4.5V
24	9	15	Brush voltage from potentiometer in air-flow sensor. Ignition on.	7 and 5	Sensor flap at rest: 200...300 mV Sensor flap fully opened: more than 4.2V
25	10	15	Dwell-period signal (input) with oscilloscope. Disengage gear and start.	32 and 5	See lower illustration
26	11	15	Not applicable	28 and 5	——
27	12	15	Starting signal term. 50. Disengage gear and start.	4 and 5	8...15 V
28	13	15	Dwell-period signal (output) with oscilloscope. Disengage gear and start.	21 and 5	See lower illustration.



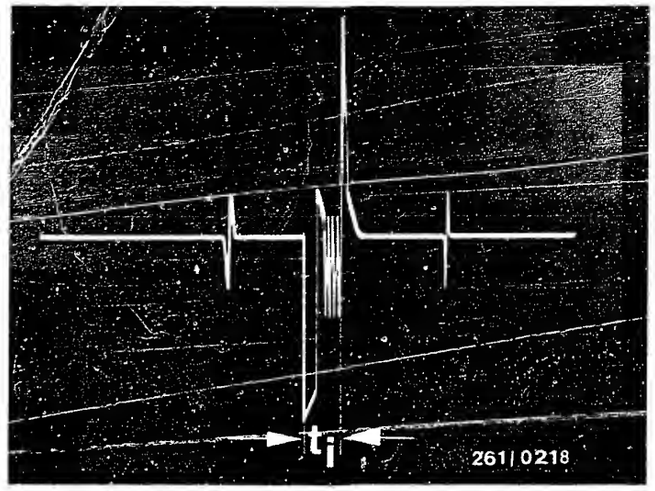
Ignition signal

t_D = Dwell period

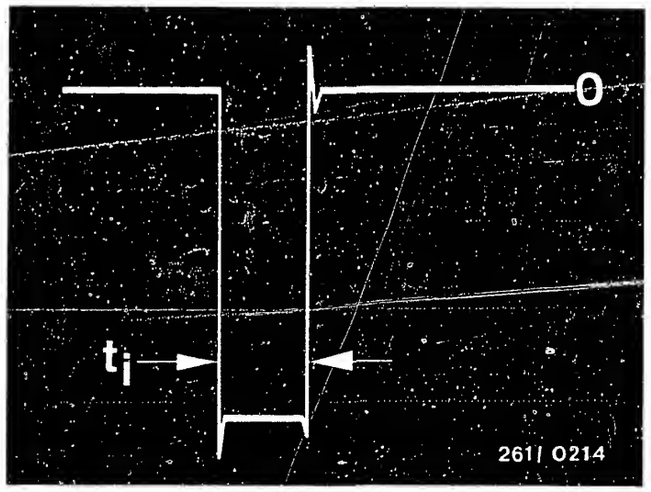


RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER (continued)

Test step	Switch position V	Switch position Ω	Button	Measurement and remarks	Measurement at control-unit plug between terms.	Test specifications (reading)
29	14	15	–	Injection signal from control unit, using oscilloscope. Disengage gear and start.	14 and 5	See upper illustration
30	14	15	T1	As 29, except after pressing button (NTC II, cold) injection duration is increased somewhat. Press button only about 2 seconds.	14 and 5	See upper illustration; t_i becomes slightly wider
31	15	15	–	As test step 29, except 2nd output for fuel-injection valves	15 and 5	See upper illustration
32	16	15	–	Injection signal from control unit, using oscilloscope. Disengage gear and start.	11 and 5	See lower illustration
33	17	15	–	Voltage at pump relay. Plug in pump fuse. Ignition on.	20 and 5	10...15 V
34	17	15	–	Voltage at pump relay. Test of pump actuation in control unit. Disengage gear and start.	20 and 5	max.4V
35	17	15	T3	Fuel-pressure test: Ignition off. Connect pressure gauge to test connection. Ignition on. Press button T3.	20 to ground	2,3...2,7bar

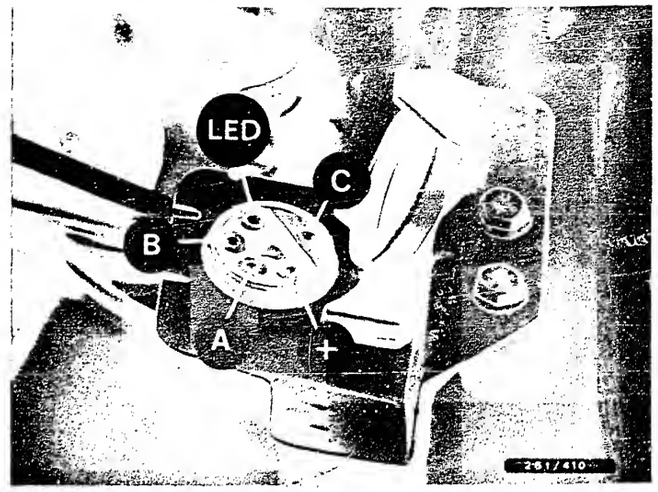


t_i = Duration of injection



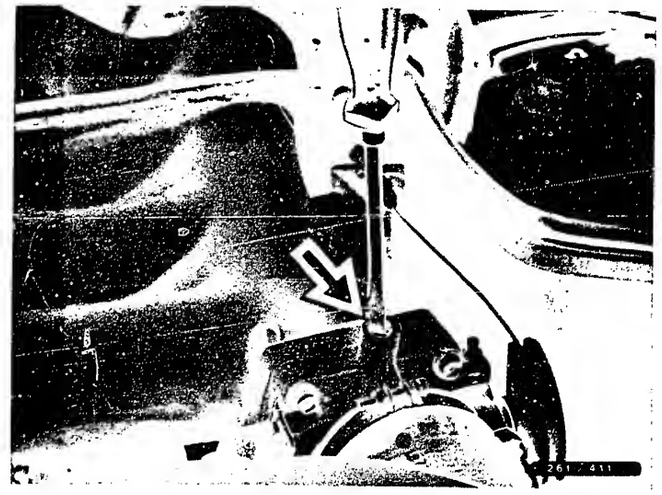
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Key	Measurement and remarks	Control-unit plug term.	Test specifications (reading)
36	17	15	–	Check CO and idle speed: connect motortester and diagnostic cable (1 684 463 095 or ..158). On vehicles with lambda closed-loop control, connect CO tester to test connection before catalytic convertor (in engine compartment on the right). When testing with adapter lead 1 684 463 124, disconnect plug connection for lambda sensor. Carry out CO measurement first. Engine temperature approx. 90°C, intake-air pressure approx. 15...30°C, consuming devices disconnected. Carry out adjustment work quickly.	———	1...1.5 vol%CO Vehicles with lambda closed-loop control: 0.4...0.8 vol. % CO
			T5 and T6	For idle-speed check and adjustment, connect at test jack term. B and term. C with lead, or press keys T5 and T6 simultaneously and read test specifications. Remove lead at test base or release keys, give short gas at accelerator pedal and check idle speed.		820...860 min $^{-1}$



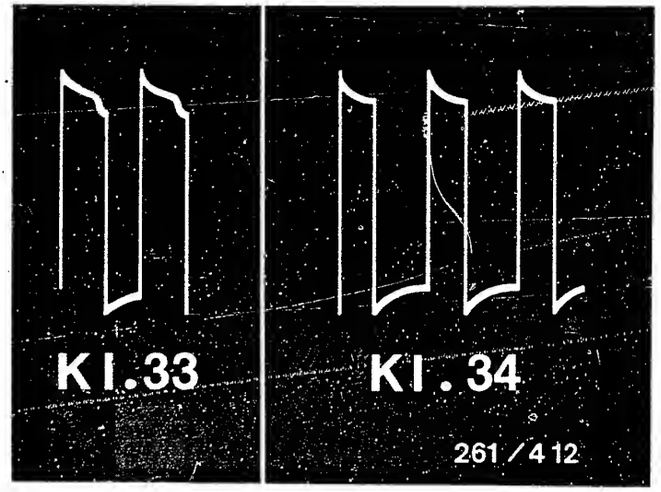
Test jack

Arrow = Adjusting screw for idle speed



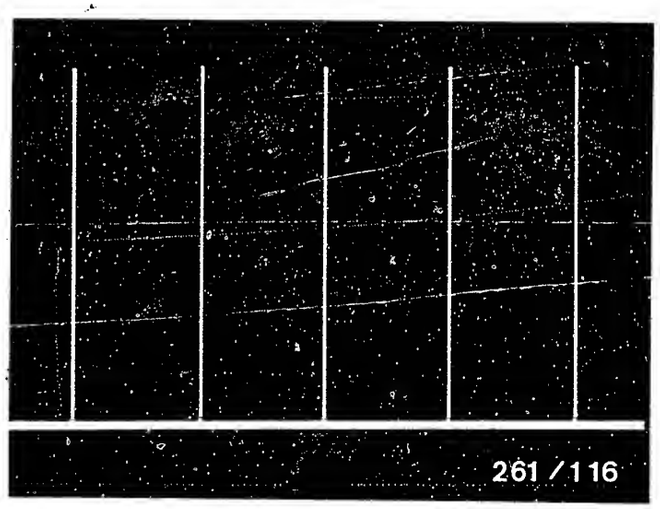
Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Key	Measurement and remarks	Control-unit plug term.	Test specifications (reading)
37	17	15	–	Check spark advance at idle speed: run engine at operating temperature at idle speed (820...860min $^{-1}$). Set engine speed exactly, otherwise incorrect spark advance will be indicated.	—	0°...10°
38	17	15	T6	Check spark advance at full load: engine at normal operating temperature. Set engine speed to 3000 min $^{-1}$. Press key T6.	3 to ground	8°...18° at 3000 min $^{-1}$
39	17	15	–	Dwell angle at idle speed	—	10°...16°
				Dwell angle at 200 min $^{-1}$	—	18°...29°
40	17	15	T5	Check overrun fuel cutoff: hold engine speed at constant 2000 min $^{-1}$. Press key T5. Injection signals stop and come back on again at approx. 1000 min $^{-1}$, etc.	2 to ground	Engine "surges"
41	18	15	–	Signal at idle actuator. Operate engine at idle speed.	33 and 5	See upper illustration
42	19	15	–	Signal at idle actuator. Operate engine at idle speed.	34 and 5	See upper illustration
43	20	15	–	Trigger signal for knock-control unit.	31 and 5	See lower illustration
44	V	10	–	Note! Voltage measurement at Ω jacks! Full-load functioning of knock-control unit is subject of testing. Briefly press accelerator pedal to full-load stop.	3 and 5	Engine idle: approx. 5 V After giving gas briefly less than 5 V



Signals at idle actuator

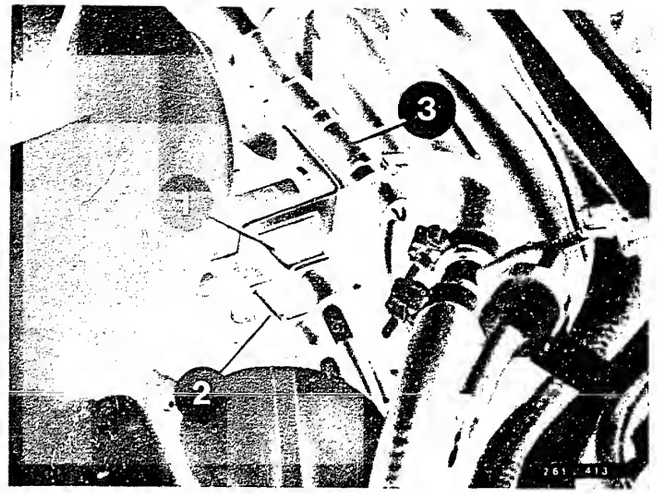
Trigger signal for knock control



Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Control-unit plug term.	Test specifications (reading)
The following test steps apply only to vehicles with lambda closed-loop control. Testing of the lambda closed-loop control can be carried out as follows: 1. With adapter lead 1 684 463 128 see test steps 45, 46, 47. 2. Without test adapter, if only adapter lead 1 684 463 124 is available for testing the Motronic, see test steps 45a, 46a, 47a. With both test methods, connect CO tester before catalytic convertor and operate engine at idle at normal operating temperature.					
45	20	22	Testing with adapter lead 1 684 463 128: testing lambda closed-loop control upper limit. Test adapter connects control unit term. 24 to ground. In order to protect catalytic convertor, carry out this test step quickly.	24 to ground	CO rises above 1.5 vol.% CO
46	20	23	As test step 45, however lambda closed-loop control lower limit. Test adapter applies + 2 V to control unit term. 24.	24 to +2V	CO falls below 0.4 vol.% CO Uneven engine idle
47	20	24	Testing of lambda sensor in closed-loop operation. Test adapter connects control unit term. 24 to lambda sensor.	24	0.4...0.8 vol.% CO
			As above, however pull air hose from pressure regulator and seal off. Immediately note CO value.		CO value briefly rises and then falls back to the above control value.

Test step	Measurement and remarks	Test spec. (reading)
Testing of lambda closed-loop control without test adapter		
45a	The upper limit of lambda closed-loop control is tested. Separate the lambda-sensor plug connection and connect the lead to the control unit (term.24) to ground. Carry out this test step only briefly, to prevent damage to the catalytic converter.	CO rises above 1,5 vol.%
46a	The lower limit of lambda closed-loop control is tested. Connect the disconnected lead to the control unit (term.24) to approx. + 2 V (e.g. 1.5 V single-cell battery, positive to term.24, negative to vehicle ground).	CO falls below 0,4 vol.%, uneven engine running
47a	The lambda sensor is tested in closed-loop operation. Reconnect the lambda-sensor plug connection.	0,4...0,8 vol.% CO
	As above, except pull off air hose at pressure regulator and seal. Immediately observe CO value.	CO value briefly rises and falls back to above control value.



1 = Plug connection for speed sensor
2 = Plug connection for reference-mark sensor
3 = Plug connection for lambda sensor

TEST SPECIFICATIONS

Pressure regulator

Fuel pressure	2,3...2,7 bar

Electric fuel pump

Delivery quantity (measured in return flow)	min. 850 cm ^{3} /30s
Connection voltage (under load):	min. 12 V

NTC – Temperature sensor I (air)

Electrical and terminal resistance, measured at air-flow sensor between term. 22 and term. 16 at ambient temperature (+15°C...+30°C):	1,45...3,3 k Ω

NTC – Temperature sensor II (engine)

Blue plug, electrical and internal resistance at ambient temperature (+ 15° C...+ 30° C):	1,45...3,3 k Ω
Engine at operating temperature (approx. + 80° C):	280... 360 Ω

Solenoid-operated injection valve

Electrical internal resistance at ambient temperature (+ 15° C...+ 30° C):	3,5...5,5 Ω

Air-flow sensor

Electrical internal resistance between:	
Term.7 (2) and term.6 (4):	8...1000 Ω (*)
Term.9 (3) and term.6 (4):	500... 800 Ω

(*) Deflect sensor flap to stop.

Test specifications (continued)

Engine-speed sensor and reference-mark sensor

Electrical internal resistance at ambient temperature (+15°C...+30°C):	600...1600 Ω

Throttle-valve sensor

Resistance of idle contact:	0 Ω

Altitude sensor

Above altitude of 1000 m (3300 ft.) contact is closed:	0 Ω
Below altitude of 1000 m (3300 ft.) contact is open:	infinite Ω

Idle actuator

Electrical internal resistance at +15°...+30°C between:	
Term.2 and term.3:	17...22,5 Ω
Term.2 and term.1:	19...25 Ω

Lambda sensor

Resistance of heating winding	6...20 Ω

Idle setting

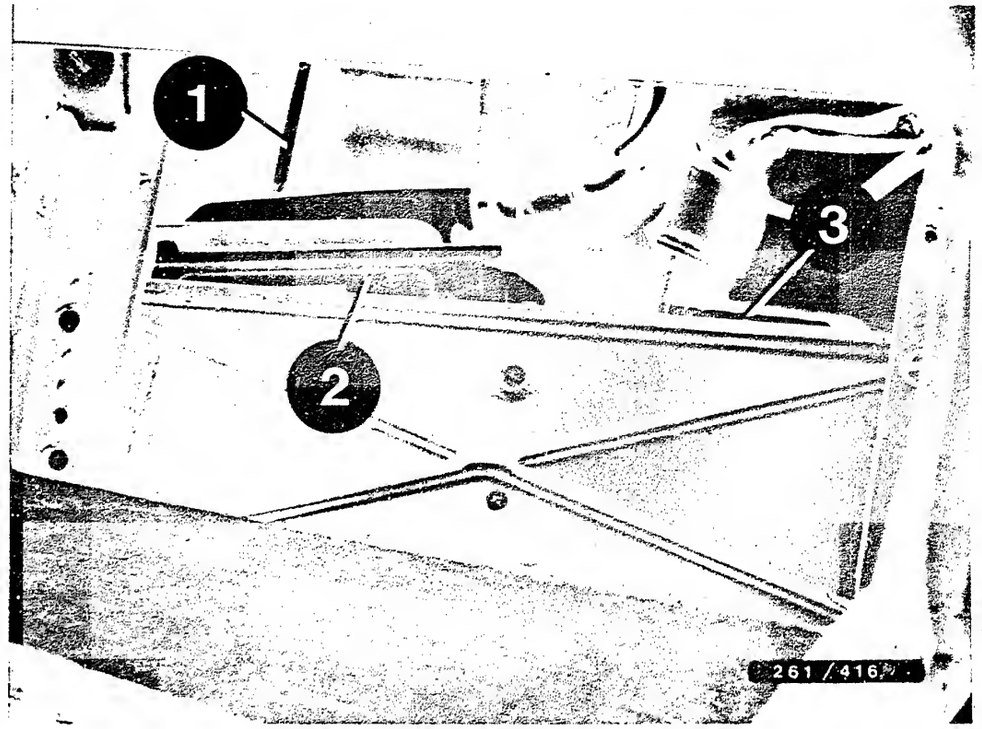
Engine at operating temperature.
Ambient temperature + 15°...+35°C.
Switch off consuming devices.

Idle speed:	820...860 min $^{-1}$
(Bridge at test jack terms. B and C)	
CO content:	1,0...1,5 vol.% CO
USA and catalyst vehicles:	0,4...0,8 vol.% CO

(Measure CO before catalytic converter, disconnect lambda-sensor plug).

For setting values for valve play and other technical engine data, see Equipment and Autodata microcard.

For production reasons:
continued on the following
coordinate.



1 = Vacuum hose to knock-control unit
2 = Motronic control unit (35-pin plug)
3 = Knock-control unit (25-pin plug)

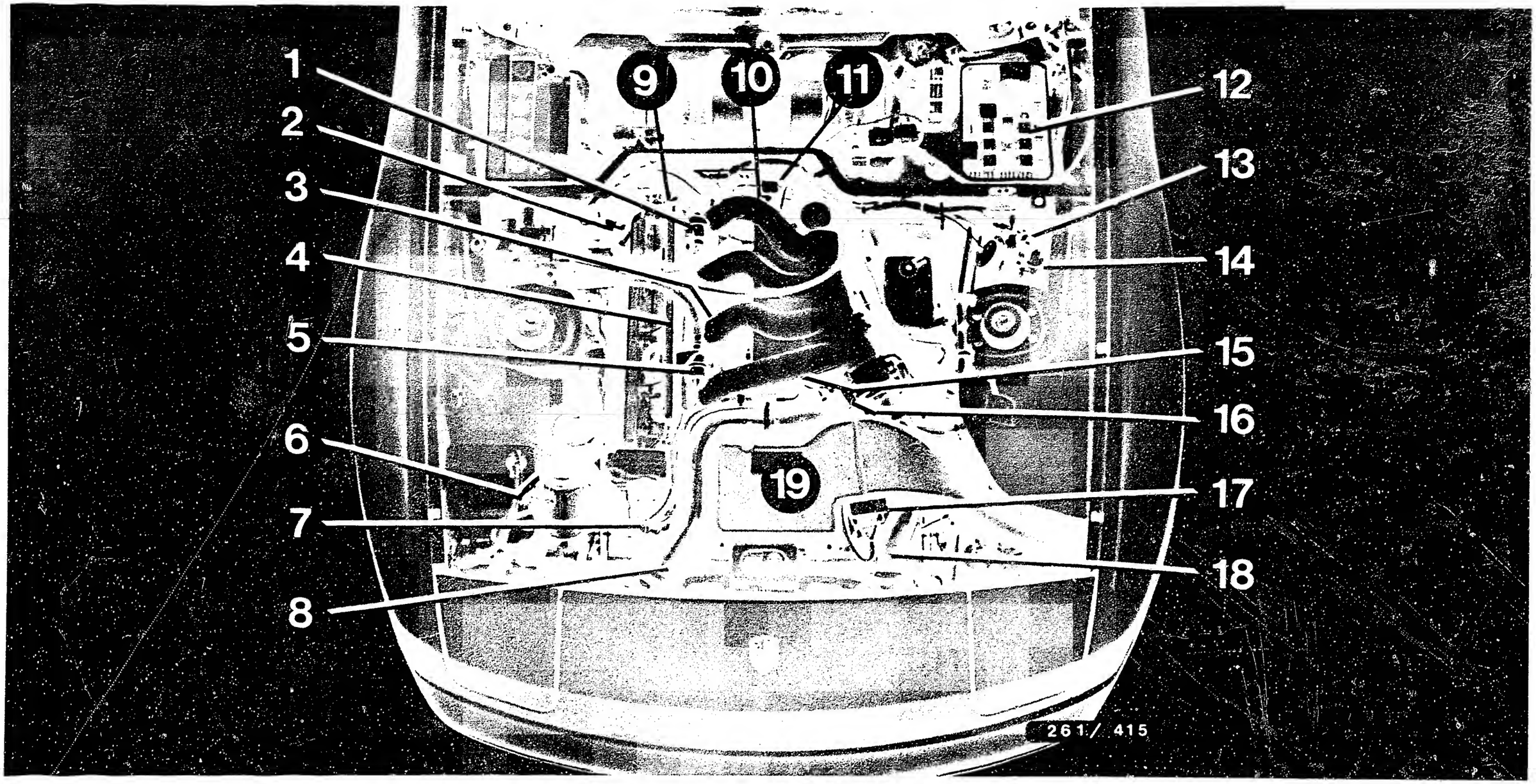
INSTALLATION POSITION OF COMPONENTS

Control unit:
On passenger side, behind footwell cover.

Altitude sensor or resistor:
Next to control unit.

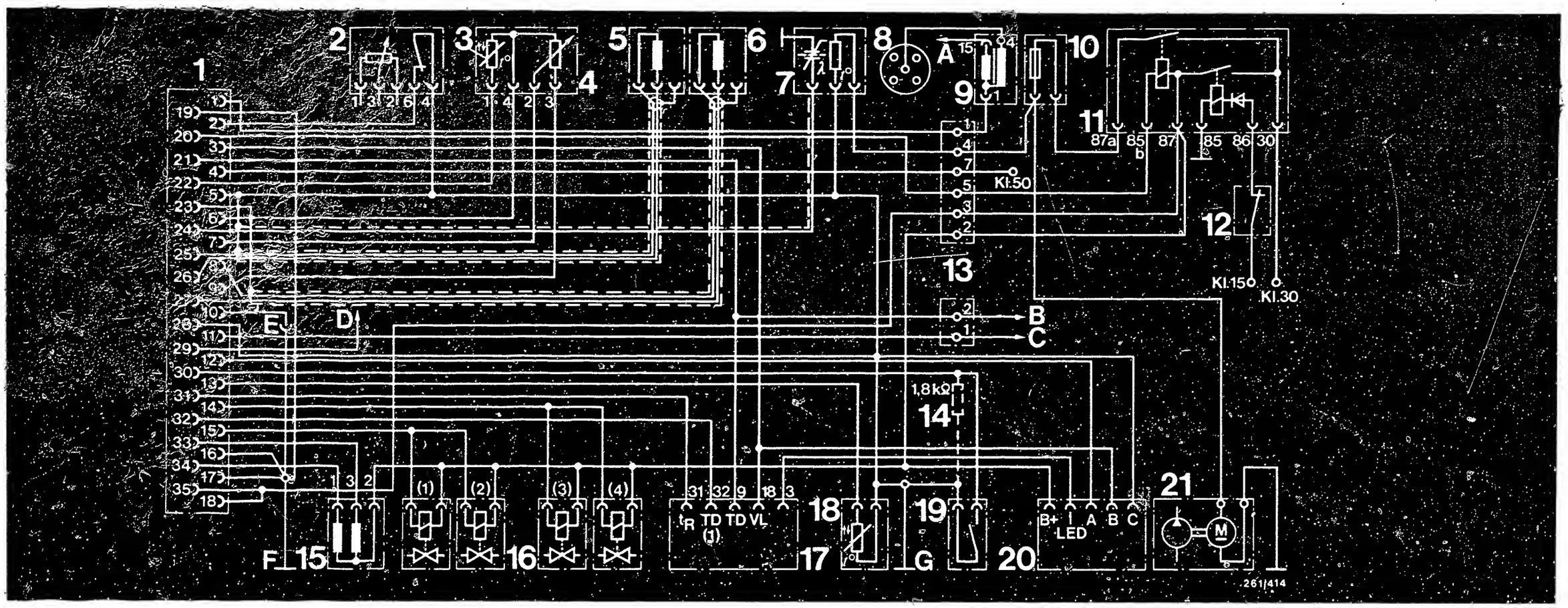
Reference-mark and engine-speed sensors:
On crankcase flange underneath oil filler inlet.

Central ground:
On clutch housing, near engine-speed and reference-mark sensors.



Engine overview

1 = Pressure regulator
2 = Exhaust manifold
3 = Idle actuator
4 = Fuel-distribution pipe with injection valves
5 = Pressure damper
6 = Ignition coil
7 = High-voltage distributor
8 = Pressure tube from exhaust turbo-supercharger
9 = Diagnostic connection
10 = Plug connections for engine-speed and reference-mark sensors
11 = Plug connection for lambda sensor
12 = Central electrics console
13 = Test socket
14 = Control valve, tank ventilation
15 = Engine-temperature sensor (NTC II). Blue plug
16 = Throttle-valve sensor
17 = Air-flow sensor
18 = Pressure tube from charge-air cooler
19 = Air filter



ELECTRICAL TERMINAL DIAGRAM

1 = Motronic control unit plug
2 = Throttle-valve sensor (potentiometer for knock control)
3 = NTC temperature sensor I (air)
4 = Air-flow sensor
5 = Reference-mark sensor
6 = Engine-speed sensor
7 = Lambda sensor, heated
8 = High-voltage distributor
9 = Ignition coil
10 = Fuse no. 34 in central electrics console
11 = Pump and main relay (G5 in central electrics console)
12 = Alarm system
13 = Plug connection in engine compartment
14 = Resistor (only in vehicles without lambda closed-loop control)
15 = Idle actuator
16 = Injection valves (cyl. 1,2,3,4)
17 = Control unit for knock control
18 = NTC temperature sensor II (engine)
19 = Altitude sensor (USA only)
20 = Test socket
21 = Fuel pump
A = To central electrics console C 32 (term. 15)
B = To engine-speed sensor
C = To consumption indicator
D = To air conditioner (B+)
E = Map plug plugged for California (USA) and S/CH/AUS
F = Ground, clutch housing
G = Ground, engine block
TD = Dwell-period signal output
TD(1) = Dwell-period signal input
t_R = Trigger signal for knock control
VL = Full-load signal

Always pay attention to SAFETY AND PRECAUTIONARY MEASURES in order to avoid damage to the engine, control unit or ignition coil, as well as to prevent danger to persons.

1. CAUTION!
   High-output ignition system with dangerous high and low voltages!

   Contact with components or terminals under voltage may be dangerous (both at the primary and secondary ends).

2. When testing the compression, disconnect the Motronic relay. In this way, undesired injection by the injection valves is avoided.

3. Never start engine when battery not firmly connected.

4. Incorrect polarity of the supply voltage, e.g. through incorrect connection of the battery or ignition coil, may lead to the destruction of the control unit.

5. Never use a fast charger for starting the engine. Provide starting aid only using a second 12 V battery and jump leads.
   Caution! Due to non-uniform demands of the vehicle manufacturer made on electronic products, we recommend that a 24 V battery never be used for providing starting aid. Observe the vehicle owner's manual.

6. Disconnect the battery from the vehicle electrical system before boost charging.

7. When charging the battery in the vehicle or providing starting aid, observe the instructions in the operating manual of the fast charger, as well as the instructions from the vehicle manufacturer.

8. Never disconnect the battery from the vehicle electrical system when the engine is running.

9. Never short circuit ignition coil term. 1 to ground (e.g. for switching off the engine). Ignition coil and, under certain circumstances, control unit are destroyed.

10. Never connect the positive battery terminal to ignition coil term. 1. Control unit is destroyed.

11. Never diconnect or connect wiring-harness plug of control unit when ignition is switched on.

12. When temperatures are above +80°C (drying oven), the control unit must be removed.

13. When welding (electric spot welding), the control unit must be removed.

14. When installing an alarm system, observe the installation instructions for Motronic vehicles or the SIS microcard ALL-500.
    Make sure that the alarm relay is not destroyed by external fields (e.g. from ignition cables) so that it responds in a defective manner.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : MB-5025

BOSCH system : Ecotronic (ECO 7)

Vehicle make : MERCEDES-BENZ

Basic microcard : MB-530

SPECIAL FEATURES

This microcard contains the trouble-shooting instructions for the Ecotronic electronic mixture-formation system for the following models valid at the time of writing:

* MERCEDES-BENZ Transporter type T1
  (210, 310, 410, 510) (09.86 ->)
  2.3 l / 4 cyl. engine (M102) 70kW (95bhp)

- Ecotronic with lambda closed-loop control (ECO7) with 25 pole control unit.
- In case of failure of a sensor, the control unit uses predetermined substitute values.
- The system is similar to Ecotronic (ECO3), Mercedes Benz 190, 200, 200 T; see SIS MB-530

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

* Universal test adapter 0 684 101 801 and
* Adapter cable 1 684 463 182

The following rapid diagnosis chart makes it possible for the experienced Ecotronic specialist to quickly check the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

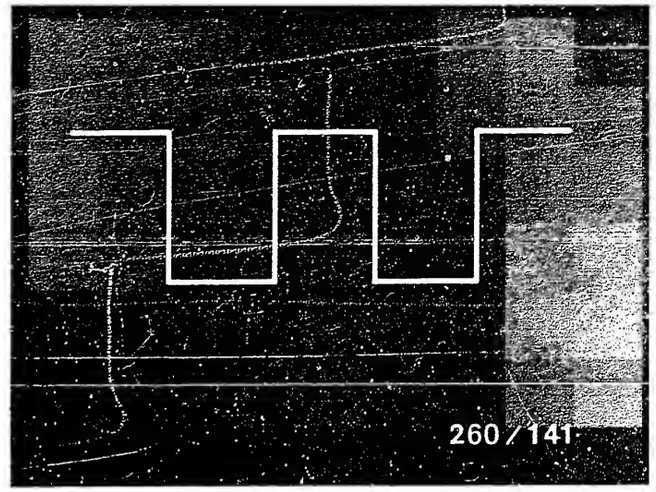
* Test-step sequence
* Position of the V- and Ω -switch
* Remarks on the operation of the universal test adapter and other components.
* Test specifications for motortester and multimeter.

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Control-unit plug between terminals	Nominal values
1	V	1	Bridge sockets 1/2 on the universal test adapter. Ignition switched off, control unit not connected. Insulation resistance of choke-valve actuator.	12 <⟹> 2	greater than 1 M Ω
2	V	3	Resistance of choke-valve actuator	12 <⟹> 10	less than 10 Ω
3	V	5	Resistance measurement of engine temperature sensor	21 <⟹> 2	+ 20°C: 2...3 k Ω + 80°C: 280...360 Ω (temperature-dependent)
4	V	7	Resistance measurement of ground leads	20 <⟹> 2	less than 10 Ω
5	V	12	Resistance of solenoid-operated valve (evacuating) in throttle-valve actuator	9 <⟹> 2	20...80 Ω
6	V	13	Resistance of solenoid-operated valve (ventilating) in throttle-valve actuator	3 <⟹> 2	20...80 Ω
7	V	20	Resistance measurement of potentiometers for throttle valve and throttle-valve actuator (parallel)	18 <⟹> 7	0,7...1,3 k Ω
8	V	21	Resistance of adjustment plug for electronic control unit CAT adjustment plug	22 <⟹> 7	0,95...11,4 k Ω
Voltage measurement: connect control unit, switch on ignition.					
9	3	21	Control unit supply voltage.	1 <⟹> 2	greater than 10 V

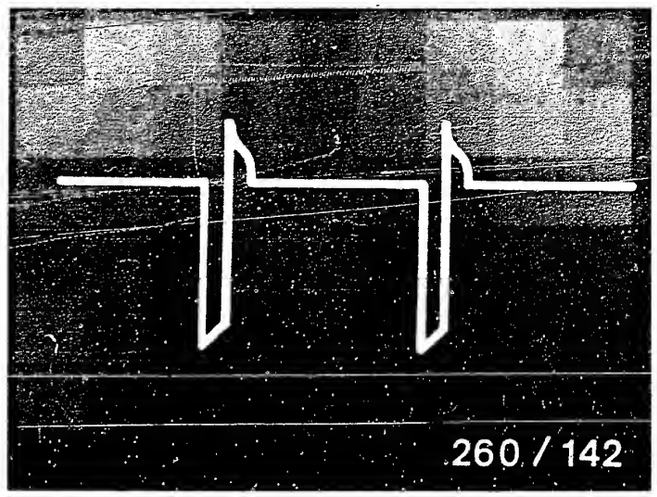
Rapid diagnosis chart for universal test adapter (continued)

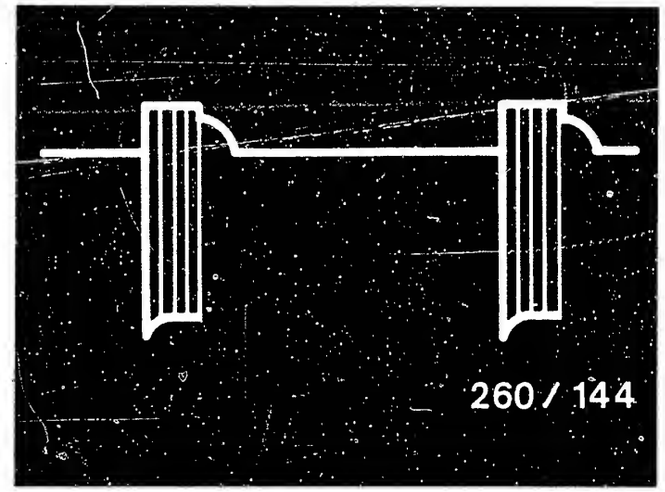
Test step	Switch position V	Switch position Ω	Measurement and remarks	Control-unit plug terminals	Nominal values
10	5	21	Connect the black terminal of the ignition oscilloscope to the black test inlet of the universal test adapter, and the red terminal to the red test inlet. Engine running at operating temperature. Measurement of engine-speed signal or pulses during the starting process.	25 <⟹> 2	See upper illustration
11	6	21	Voltage supply, term. 15	13 <⟹> 2	greater 10 V than
12	7	21	Supply voltage for potentiomers (throttle valve and throttle-valve actuator)	18 <⟹> 2	4,5...5,5 V
13	8	21	Voltage supply, relay, intake manifold/bypass heating	14 <⟹> 2	greater than 10 V
14	9	21	Air conditioner recognition (only on vehicles with air conditioner). Switch on air conditioner.	19 <⟹> 2	greater than 10 V
15	10	21	Test throttle-valve actuator: Remove bridge from sockets 1/2 on universal test adapter. Push button T4 on universal test adapter. The tappet of the throttle-valve actuator moves into overrun position. Engine goes out. Value can change by max. 30 V within 0,2 sec.	17 <⟹> 2	0,1...0,8 V | V after 30 sec. +max. 0,2 V



Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Control-unit plug terminals	Nominal values
16	11	21	Test throttle-valve potentiometer: Slowly depress accelerator pedal all the way. The voltage should climb steadily between min. and max.	11 <==> 2	Min: 0,05...0,6 V Max: 4,2...5,5 V
17	10	21	Test throttle-valve actuator (ventilating side): Connect cable from socket 2 on universal test adapter to positive for 1 sec. (e.g. battery positive or term. 30 on central electrics console).	17 <==> 2	0,1...1,0 V | after 1 sec. | V 2,8...4,2 V
18	12	21	Measurement of choke-valve actuator signal: Restore bridge between sockets 1 and 2 on universal test adapter. Start engine.	12 <==> 2	See upper illustration
19	12	21	Acceleration enrichment: Briefly press accelerator pedal. Signal becomes wider.	12 <==> 2	See lower illustration
20	13	21	Actuation of ventilating valve in throttle-valve actuator: Switch off ignition. Subsequently observe time and voltage values.	3 <==> 2	less than 1 V after approx. 1...3 s greater than 10 V After further approx. 1...5 s less than 1 V
21	14	21	Start engine. Actuation of evacuating valve in throttle-valve actuator: Switch off ignition. Subsequently observe time and voltage values.	9 <==> 2	less than 1 V after ign. off greater than 10 V approx. 3 s less than 1 V





Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Control-unit plug terminals	Nominal values
22	18	21	Start recognition (term. 50). Start engine.	16 <==> 2	gtr. than 6 V during starting process
23	4	21	Lambda closed-loop control open-loop control value at integrator output. Engine idling at operating temperature. Carry out testing of lambda closed-loop control with analog tester.	23 <==> 2	5...7 V Note value
24	4	22	Lambda closed-loop control rich value at test output. Engine speed greater than 2000 min $^{-1}$	23 <==> 2	less than 2 V
25	4	23	Lambda closed-loop control lean value at integrator output. Engine speed greater than 2000 min $^{-1}$.	23 <==> 2	greater than 9 V
26	4	24	Lambda closed-loop control closed-loop value at integrator output. Test value oscillates (± 0,5 V) around the open-loop control value obtained in test step 23.	23 <= > 2	5...7 V

TEST SPECIFICATIONS

Idle speed:	740 ±40 min-1
Fuel pressure:	0,1...0,3 bar
Minimum fuel delivery quantity (at approx. 2000 min $^{-1}$) approx.	1,0 ltr/min
Float weight: (dry)	7,9 ±0,5 g
Float level:	27,5 ±1,0 mm
Throttle-valve potentiomer total resistance:	1,4...2,6 k Ω
Slider resistance within actuation range:	min. less than 270 Ω max. 1,4...2,4 k Ω
Choke-valve actuator: Winding resistance:	0,9...1,7 Ω
Temperature sensor (coolant):	at +20°C: 2,2...2,8 k Ω at +80°C: 290...364 Ω
Intake-manifold preheating: Resistance of honeycomb heating element:	at 20°C: 1,2 Ω
Resistance of bypass heating element:	at 20°C: 2,7 Ω

Test specifications (continued)

Throttle-valve actuator	
Evacuating valve (term.2/term.3):	20...70 Ω
Ventilating valve (term.2/term.8):	20...70 Ω
Total resistance of potentiometer (term.4/term.5):	1,4...2,6 k Ω
Slider resistance within actuation range (term.4/term.7):	min. less than 400 Ω max. 1,4...2,4 k Ω
Basic setting of throttle valve stage II:	0,02 ±0,02 mm
Release and positive return stage II:	Y = 0,8 ±0,2 mm Z = 0,4 ±0,2 mm
Resistance of lambda sensor heating element: at 20°C:	4,3 Ω
Tightening torque for carburetor mounting:	7 Nm

Test specification (continued)

Lambda closed-loop control integrator measurement output

Open-loop control value:		5...7 V
	or	50 % on-off ratio
Rich value	: less than	2 V
	or greater than	80 % on-off ratio.
Lean value	: greater than	9 V
	or less than	20 % on-off ratio.
Closed-loop control control value	: oscillates about open-loop control value	

Control range of throttle-valve actuator:

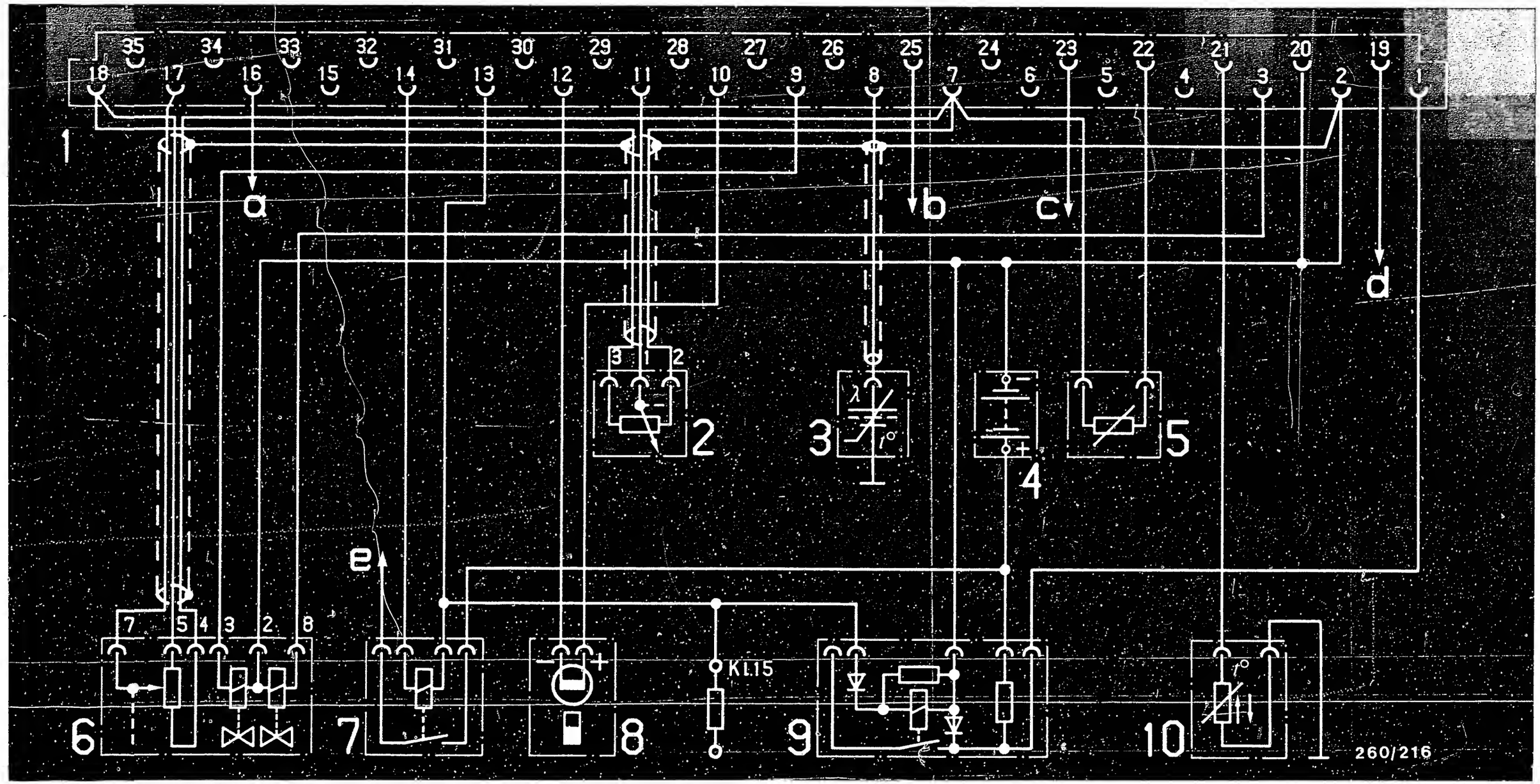
Set with feeler gauge. (2,15 ±0,05 mm)

For production reasons:
continued on the following coordinate.

Nozzles fitted:

	1rst stage	2nd stage
Main nozzle	x110	x135
Idle fuel nozzle	x 50	70
Off-idle nozzle		
Air correction nozzle (with mixing tube)	x92,5	x70

See equipment and Autodata microcards for setting values for valve play and other technical engine data.

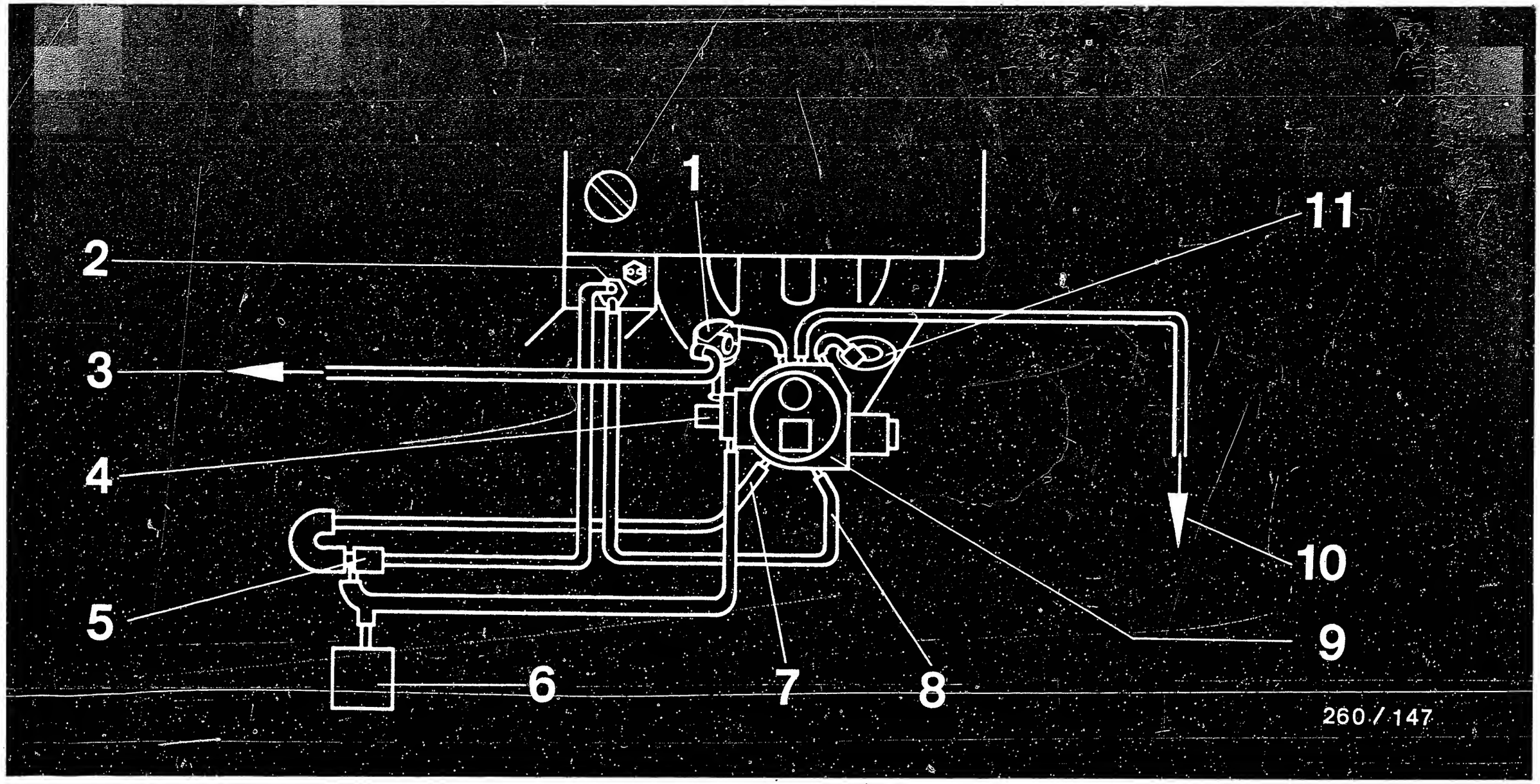


ECOTRONIC ELECTRICAL TERMINAL DIAGRAM

1 = Ecotronic control unit
2 = Throttle-valve potentiometer (HD potentiometer)
3 = Lambda sensor (heated)
4 = Battery
5 = Adjustment plug (CAT/retrofit)
6 = Throttle-valve actuator
7 = Control relay for bypass and intake-manifold heating
8 = Choke-valve actuator
9 = Over-voltage protection relay
10 = Temperature sensor
a = Starting recognition (term. 50)
b = TD signal
c = Lambda closed-loop control integrator measurement output
d = Air conditioner recognition
e = To heating element for bypass/ intake-manifold heating

K15 ⟹

K16 ⟸



AIR-LINE DIAGRAM (VACUUM LINES)

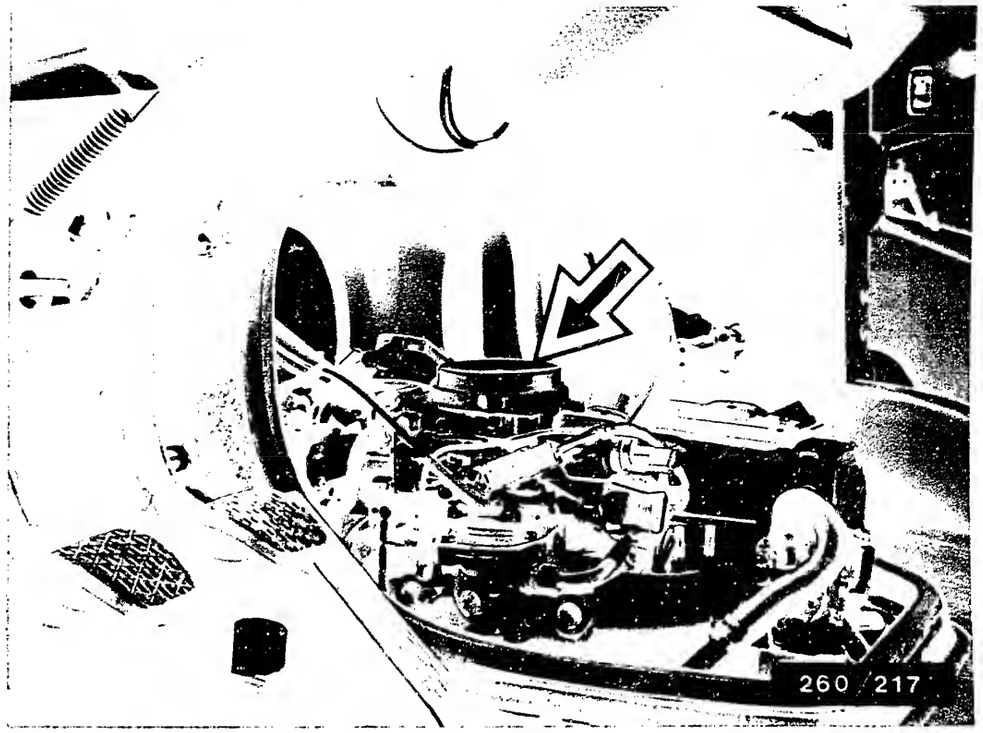
1 = Throttle-valve actuator
2 = Thermo-valve (open at coolant temperature of 50°C)
3 = In vehicle interior
4 = Float-chamber change-over ventilation valve
5 = Pneumatic change-over valve (open at approx. 30 mbar)
6 = Activated carbon filter
7 = Regeneration line
8 = Control line for regeneration
9 = Carburetor
10 = To ignition trigger box
11 = Vacuum unit stage II

2,5,6,7, and 8 = regeneration device (country-specific)

K17 ⟹
K18 ⟸

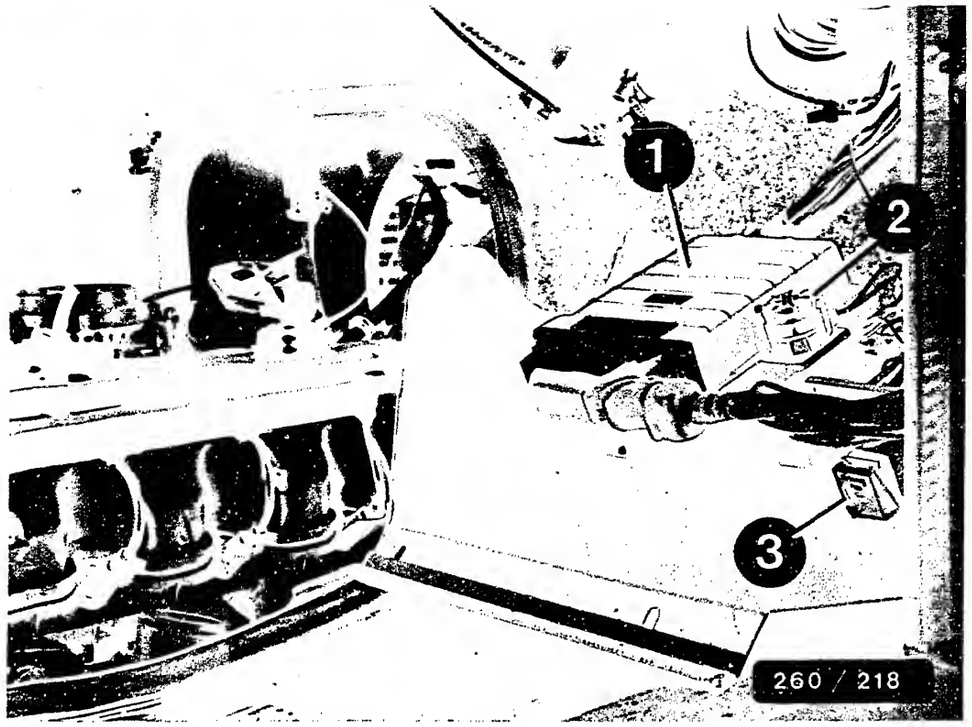
TEST EQUIPMENT AND TOOLS

Description	Designation	Part no.
Universal test adapter	ETT 018.01	0 684 101 801
Adapter cable		1 684 463 182
Motortester	e.g. MOT 201	0 684 000 201
Calibrated infrared exhaust-gas analyzer	e.g. ETT 008.14 e.g. ETT 008.15	0 684 100 814 0 684 100 815
Pressure-vacuum tester	e.g. ETT 007.01	0 684 100 701
Feeler gauge for adjusting throttle-valve section 2,15 ±0,05 mm		Available from: Korinth co. Ludwig-Kloos-strasse 21 6450 Hanau 7/ Steinheim West Germany
Measuring tool for throttle-valve adjustment		
Vacuum pump	e. g. Mityvac	
Corrosion protection agent or "Termal" all-purpose spray	WD 40	Commercially available
Electric tester or multimeter	e.g. ETE 014.00 or Philips co. PM 2517 X or Miselco co. Master 50 K	0 684 101 400
Lambda sensor mounting paste	VS 140 16 Ft	5 964 080 105



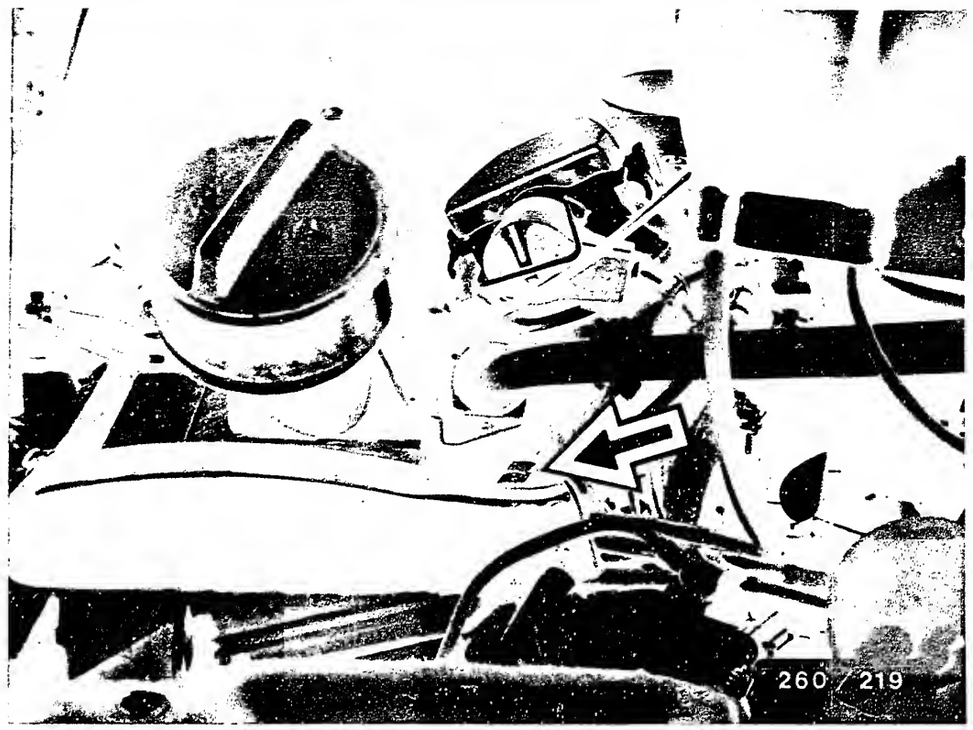
INSTALLATION POSITION OF COMPONENTS

The carburetor (arrow) is installed on the left in the direction of travel.



The Ecotronic control unit (1), the adjustment plug (2), and the relay for intake-manifold and bypass heating (3) are installed in the right footwell underneath the covering.

Remove the upper fastening screws of the cover and fold downwards.



The temperature sensor is installed on the left in the direction of travel (arrow).

Trouble-shooting instructions : REN - 5002

BOSCH system : K - Jetronic

Vehicle make : RENAULT

Basic microcard : REN - 01/J1

TABLE OF CONTENTS

SPECIAL FEATURES

These instructions contain the K-Jetronic trouble-shooting instructions, valid at the time of publication, for the following RENAULT model:

R25 - V6 Injection 03.86->
2.8 l/6-cyl. engine (PRV engine)

* Lambda closed-loop control and catalytic converter
* Low-idle-speed control
* Pressure-urge switch for cold-start ignition advance (temperature lower than 55°C)
* In-tank pre-supply pump
* Downdraft mixture-control unit
* Air-flow sensor with angle sensor (potentiometer) for fuel-consumption indicator
* Warm-up regulator with altitude compensation

Important note: If reference is made to a basic microcard, always make sure you use the test specifications from the vehicle-specific brief instructions.

SAFETY AND PREVENTATIVE MEASURES

Always pay close attention to safety and preventative measures, in order to prevent damage to the engine, control unit, or the ignition coil, as well as endangering persons.

* CAREFUL!
  High-performance ignition system with dangerous high and low voltages!

  Contact with voltage-bearing parts or terminals can be fatal (on both primary and secondary sides).

* Never start the engine without the battery securely connected.

* Incorrect polarity of the supply voltage, e.g. due to incorrect connection of the battery, can lead to the destruction of the control unit.

* Never use a fast charger to start the engine.
  Render starting assistance only with a second 12 V battery and jumper cables.

* Disconnect the battery from the vehicle electrical system prior to boost charging.

* When charging the battery in the vehicle or rendering starting assistance, observe the instructions in the operating manual of the fast charger, as well as the vehicle manufacturer's instructions.

* Never disconnect the battery from the vehicle electrical system while the engine is running.

* Never disconnect or connect the wiring-harness plug of a control unit while the ignition is switched on.

Safety and preventative measures (continued)

* Before exposure to temperatures above + 80°C (paint drying installation), remove the control units.

* The control units must be removed prior to welding work (electrical spot welding).

* Never deflect (press down) the sensor plate while the electric fuel pump is running, since this would cause fuel to be injected. Subsequent starting-motor operation could lead to very serious engine damage.

* When testing the fuel injection valves with a valve-testing device, observe the test agent specifications.
  Never use normal gasoline or other easily-inflammable fluids for testing. Even when using white spirit, be sure to observe local safety regulations.

* Test the engine induction system for sealing only with an approved leak-detector spray (e.g. Gypoflex). Do not use easily-inflammable fluids. Observe local safety regulations.

TROUBLE-SHOOTING CHART

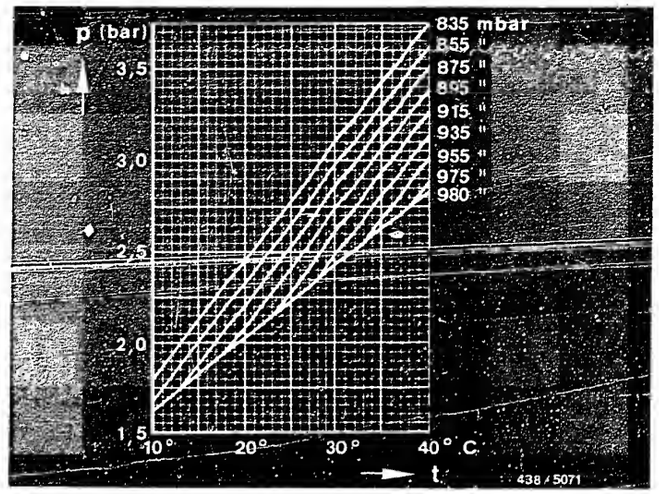
Customer complaint (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idling problems (engine speed, exhaust).	4. Poor throttle response.	5. Engine missing (ignition, injection).	6. Insufficient maximum power/ speed.	7. Excessive fuel consumption.	8. Engine dieseling.	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component defect)
*	*			*							Electric fuel pump
*		*	*		*						Induction system
*											Fuel system
*		*	*	*	*		*				Fuel distributor
*		*	*	*	*		*				Air-flow sensor
*		*				*	*				Cold-starting system
*		*		*			*				Fuel-injection valves
	*			*	*						Primary pressure
*	*	*	*	*	*	*					Control pressure
*		*	*		*						Overall delivered-quality scatter
					*						Throttle valve
*		*	*			*	*				Lambda closed-loop control
*		*	*			*	*				Low-idle-speed control

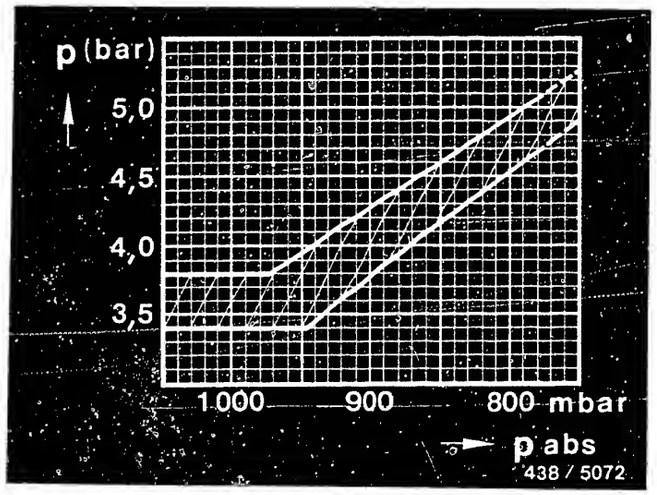
For production reasons: continued on the following coordinate.

TEST SPECIFICATIONS

No.	Testing/Test condition	Set value
1	Electric fuel pump – fuel delivery: Supply voltage (under load):	at least 1600 cm ^{3} /min at least 11,5 V
2	Fuel delivery – control-pressure circuit:	160...240 cm ^{3} /min
3	Fuel distributor – primary pressure: Test specification: Setting value:	 5,2...5,9 bar 5,4...5,6 bar
4	Control pressure: Warm-up regulator with altitude compensation. Take the control-pressure set value "cold" corresponding to ambient temperature and atmospheric pressure from top chart. Tolerance of base curve: ± 0.2 bar. Tolerance of altitude curves: ± 0.25 bar. The base curve applies for atmospheric pressure ≥ 980 mbar. Take control-pressure set value "warm" from bottom chart. The control pressure "warm" must be measured immediately after adjustment of the warm-up reg.	
5	Leakage test – overall system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 3,2 bar 3,0 bar
6	Injection-valve opening pressure: Leakage test not below 2,8 bar: No drop must fall within 25 s.	3,7...4,8 bar



p = Control pressure
(gauge pressure)
t = Ambient temperature
p abs. = Air pressure



Test specifications (continued)

No.	Testing/Test condition	Set value	
7	Fuel deliveries/comparative measurement:	Adjusting point: (cm^3 /min)	Max. perm. flow: (cm^3 /min)
	Idle:	6,0	6,7
	Part load:	40,0	42,0
	Full load:	195,0	210,0
	Min. flow at max. air-flow sensor plate deflection:	195,0 cm^3 /min	
8	Thermo-time switch – resistance measurement:	Below + 30°C	Above + 40 °C
	Terminal G and ground:	25...40 Ω	50... 80 Ω
	Terminal W and ground:	0 Ω	100...160 Ω
	Terminal G and terminal W:	25...40 Ω	50... 80 Ω
9	Idle adjustment*		
	Idle speed (controlled):		
	Manually-shifted transmission:		850...950 min^{-1}
	with on/off ratio:		28...32 %
	Automatic transmission:		700...800 min^{-1}
	with on/off ratio:		28...32 %
	On/off ratios:		
	at least:		Approx. 26 %
	maximum "warm":		Approx. 70 %
	maximum "cold":		Approx. 90 %

* For adjusting and/or checking the idle speed, switch off the air conditioner. Engine at normal operating temperature, oil temperature approx. +80°C. The radiator fan must not be running during adjustment. Adjust the on/off ratio at idle speed by means of the idle-speed bypass screw.

Test specifications (continued)

No.	Testing/Test condition	Set value
10	Lambda closed-loop control*	
	CO concentration:	0,7...1,0 % by vol.
	On/off ratios:	
	Oscillating closed-loop control, mean value:	45...55 %
	t_0 (lean stop):	max. 20 %
	t_1 (control):	45...55 %
	t_2 (rich stop):	min. 85 %
	t_3 (warm-up enrichment):	55...65 %
	t_4 (full-load enrichment):	55...65 %
	t_5 (cold idle enrichment):	55...65 %
	Timing valve, internal resistance at +20°C:	2... 3 Ω

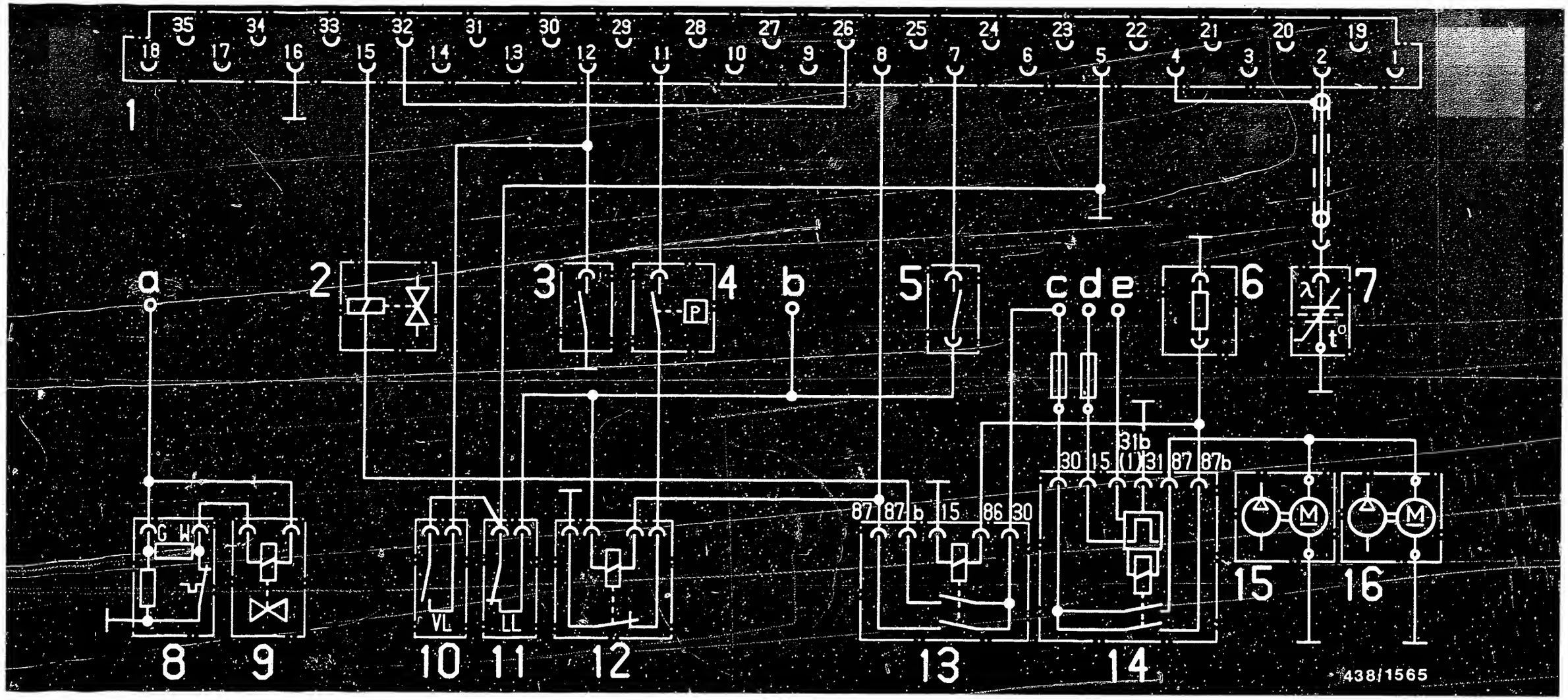
* Adj. of the Lambda closed-loop control by means of the idle-mixture-adjusting screw.

Measurement of the CO concentration at exhaust-sample bores at the end of the exhaust manifold. To do this, disconnect the Lambda probe.

Warm-up enrichment at temperatures < 15°C, recognition via temperature switch +15°C.

Full-load enrichment at throttle-valve opened angle < 50°, recognition via full-load switch.

Cold idle enrichment at temperatures < 60°C, recognition via temperature switch +60°C and idle switch.

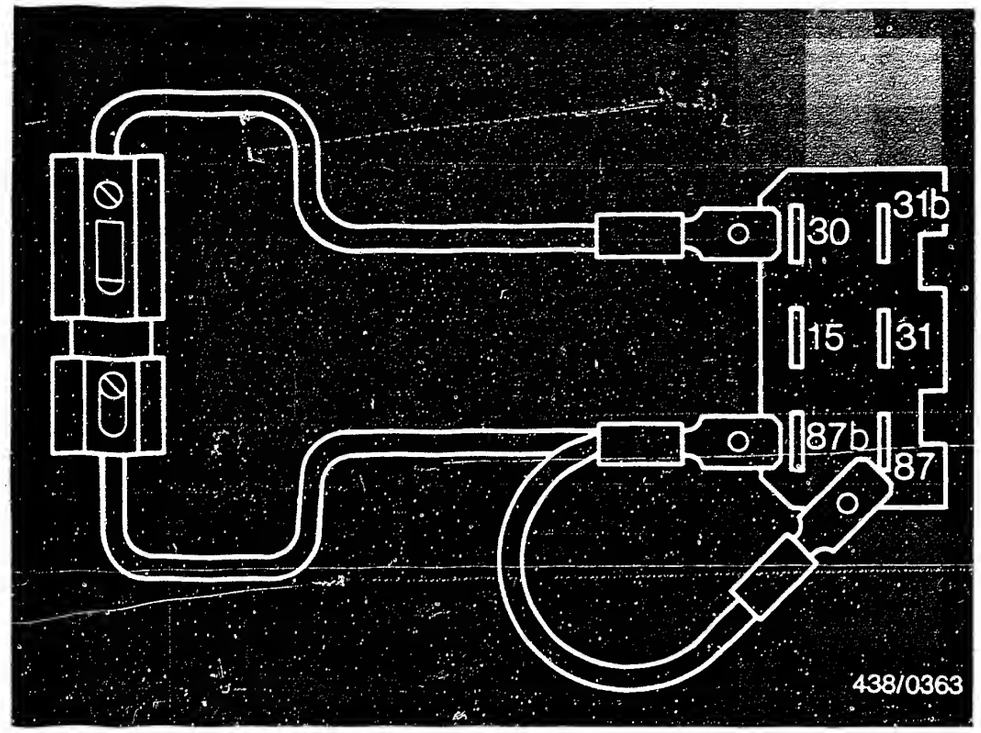


1 = Control unit for lambda closed-loop control
2 = Timing valve
3 = Temperature switch 15°C
4 = Pressure-surge switch
5 = Temperature switch 60°C
6 = Warm-up regulator
7 = Lambda sensor
8 = Thermo-time switch
9 = Start valve
10 = Throttle-valve switch, full load
11 = Throttle-valve switch, idle
12 = Relay
13 = Main relay
14 = Electronic engine-speed relay
15 = Electric fuel pump
16 = In-tank pre-supply pump

a = Terminal 5a
b = Idle-speed regulator terminal 8
c = Terminal 30
d = Terminal 15
e = Terminal 1

ELECTRICAL TERMINAL DIAGRAM WITH SAFETY CIRCUITRY FOR ELECTRIC FUEL PUMP

L13 ⟹ L14 ⟸



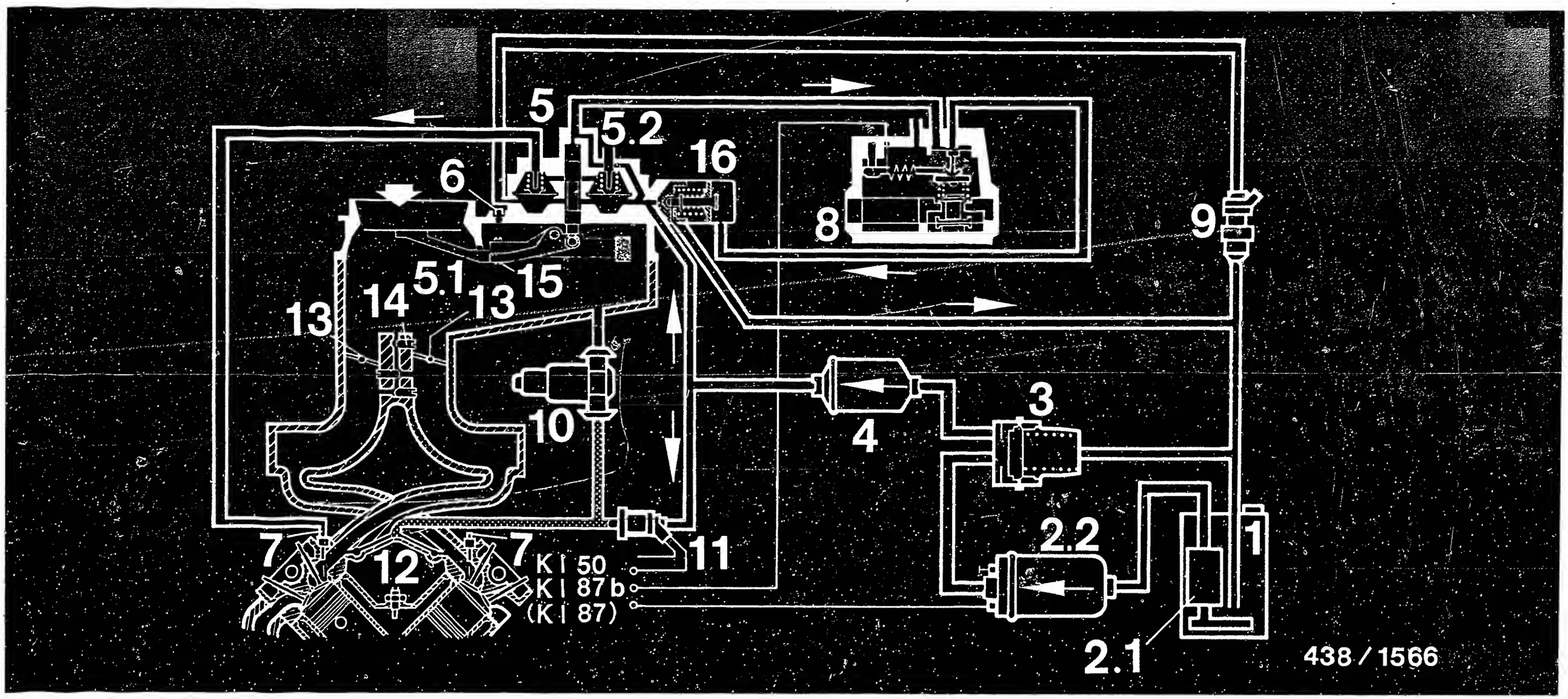
BRIDGING SAFETY CIRCUITRY

Remove the electronic engine-speed relay from the plug base.
Connect contacts 87 and 87b to contact 30 in the plug base using a double bridge. Use a 1.5 mm ^{2} connecting cable with fuse link and 16 ampere fuse.

This supplies the electrical fuel pump, pre-supply pump, and warm-up regulator with battery voltage.

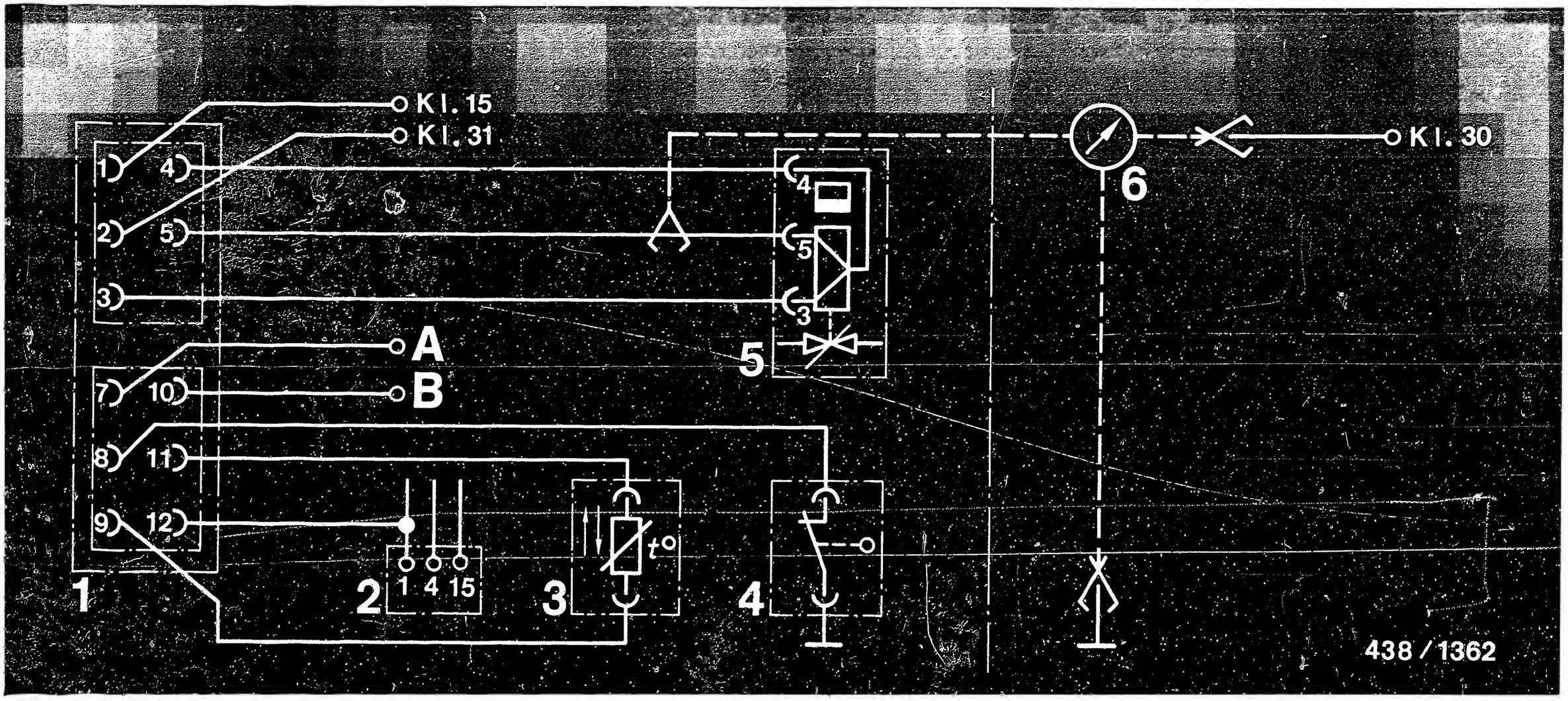
I m p o r t a n t :
Never deflect (press down) the sensor plate while the electric fuel pump is running, since this would cause fuel to be injected through the injection valves. Subsequent starting-motor operation could lead to very serious engine damage.

For production reasons:
continued on the following
coordinate.



1 = Fuel tank
2.1 = In-tank pre-supply pump
2.2 = Electric fuel pump
3 = Fuel accumulator
4 = Fuel filter
5 = Mixture-control unit
5.1 = Air-flow sensor
5.2 = Fuel distributor
6 = Securing cap
7 = Fuel-injection valves
8 = Warm-up regulator
9 = Timing valve
10 = Idle actuator
11 = Start valve
12 = Thermo-time switch
13 = Throttle valve
14 = Idle-speed bypass screw
15 = Idle-mixture-adjusting screw
16 = Primary-pressure regulator with push valve

AIR/FUEL-LINE DIAGRAM



1 = Low-idle-speed regulator (control unit)
2 = Ignition coil
3 = Engine temperature sensor
4 = Throttle-valve switch, idle
5 = Idle actuator
6 = Lambda closed-loop control tester (e.g. KDJE-P 600)
A = A/C connection
B = Test pin

LOW-IDLE-SPEED CONTROL

The idle speed is controlled by the low-idle-speed regulator (control unit) and the idle actuator. Instead of an auxiliary air device, the idle actuator is installed in the air bypass to the throttle valve. Connect a lambda closed-loop control tester to measure the on-off ratio.

INSTALLATION POSITION OF COMPONENTS

* Electric fuel pump:
  On the right rear frame side member

* Fuel filter:
  In engine compartment, on left spring strut dome.

* Pressure-surge switch:
  In engine compartment, on inside right fender
  near battery.

* Timing valve:
  In engine compartment in front of air-flow sensor.

* Control unit for low-idle-speed control:
  In engine compartment on inside left fender on
  mounting plate (in plastic housing)

* Lambda closed-loop control unit, main relay:
  In passenger compartment below glove compartment.

* Electronic engine-speed relay:
  In passenger compartment, on the left below the
  dashboard.

For production reasons:
continued on the following
coordinate.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : BMW - 5002

BOSCH system : Active check control unit

Vehicle make : BMW

Basic microcard : BMW-00/E81

SPECIAL FEATURES:

These trouble-shooting instructions apply to all BMW models current at the time of writing:

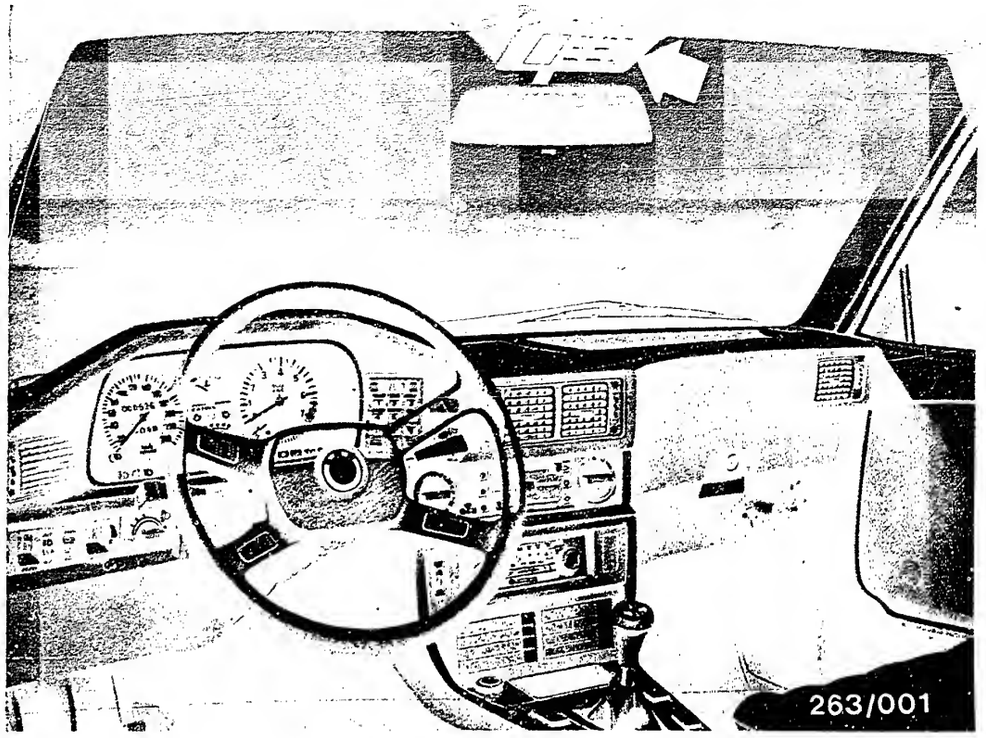
* 535i with Motronic

Tail lamp/ licence-plate lamp	Approx. 0.5 second display delay
Lower beam:	Approx. 0.5 second display delay
Stop lamp:	When ignition and starting switch is in "radio" position, any fault is indicated when brake pedal is pressed or in case of fuse failure
Coolant/washer fluid:	If a fault is already present at initial operation or when the ignition and starting switch is in the "radio" position, a fault indication is given with approx. 0.5 second delay. If the fault arises during travel, the sensor signal must be present at the fault display for at least 10 seconds before the fault is indicated by the appropriate LED and simultaneous illumination of the "CHECK" sign.
Engine oil:	Display delay approx. 10 seconds. If the dynamic oil level is too low upon initial operation or if the sensor lead is interrupted, the fault is indicated with a delay of approx. 0.5 seconds.

TROUBLE-SHOOTING CHART

The following table shows the possible failure symptoms.

Failure symptom
No display at display unit
Character illumination does not come on.
Individual functions, such as oil level, washer fluid, coolant, or stop/tail/licence-plate lamp are not indicated.
All LED's are illuminated and graph panel illumination does not go out.



RAPID TESTING OF DISPLAY UNIT OF CHECK CONTROL UNIT

The display unit is located above the rear-view mirror (arrow) and is held in place by clips.

If, when a fault occurs, it cannot be ascertained whether the defect is in the display unit or in the peripherals, such as wiring harness or sensor, then replace the display unit with a new unit.

If the fault is still indicated, connect adapter KDVM 7601 to the wiring-harness plug and test per rapid diagnosis chart.

If the fault is no longer indicated, the display unit is defective.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART FOR ACTIVE CHECK CONTROL UNIT

The following rapid diagnosis chart makes it possible for the experienced specialist to rapidly test the check control unit of the system using test adapter KDVM 7601.

On the periphery of the check control unit, leads are tested for continuity, starting with the check control unit plug (pin..) and proceeding to the components of the system, or sensors and lamps.

Testing is carried out using an ohmmeter or voltmeter. The test adapter must be connected accordingly.

The contents of this list are limited to the following information:

* Test-step sequence
* Switch position on adapter
* Operation in vehicle
* Test instructions and specifications

If detailed information and instructions are necessary for trouble-shooting, always proceed per basic micro-card BMW-00/E81.

TEST CHART FOR TEST ADAPTER KDVM 7601

Test step	Switch position	Terminals	Test of components/function	Test instructions/ conditions	Nominal values
1	0	—	Supply voltage OFF	—	—
2	1	1	Supply voltage	Ignition and starting switch in "radio" position	greater than 11,5 V
3	2	2	Central indicator lamp (CHECK sign)	Connect sockets for voltmeter on test adapter. Ignition "ON"	CHECK lights up
4	3	4	Ignition and starting switch and headlamp switch / supply voltage	Ignition "ON"	greater than 11,5 V
5	4	5	O_2 sensor	Only on export vehicles	greater 20 k Ω
6	5	6	Air bag term.+	Only on export vehicles	greater 20 k Ω
7	6	7	Air bag term.–	Only on export vehicles	less 20 Ω
8	7	8	Seat belt buckle (Fasten seat belts)	Only on export vehicles	greater 20 k Ω
9	8	9	Vehicle ground	———	less 20 Ω
10	9	11	Headlamp switch terms. 58 R and 58 S and bulb monitoring unit term. 58 R	Ignition "ON" Parking lights switched on	greater 11,5 V
11	10	12	Headlamp switch and bulb monitoring unit term. 58 L	Ignition "ON" Parking lights switched on	greater than 11.5 V
12	11	13	Bulb monitoring unit term. 58 KL including left tail light	Parking lights switched on	less than 20 Ω
13	12	15	Ignition and starting switch and headlamp switch term. 30 supply voltage	———	greater than 11,5 V

TEST CHART FOR TEST ADAPTER KDVM 7601 (CONTINUED)

Test step	Switch position	Terminals	Test of components/function	Test instructions/ conditions	Nominal values
14	13	16	Oil-level sensor	If static oil level is OK	less than 20 Ω
15	14	17	Washer fluid sensor	If washer-fluid level is OK	less than 20 Ω
16	15	18	Coolant sensor	If coolant level is OK	less than 20 Ω
17	16	20	Oil-level sensor	If oil level is dynamically OK Oil level not dynamically OK If a lead is interrupted	1 k Ω less than 50 Ω greater than 5 k Ω
18	17	21	Bulb monitoring unit, lower beam and upper beam relay	Ignition "ON" Lower beams switched on	greater than 11,5 V
19	18	22	Bulb monitoring unit Lower beams	Ignition "ON". Both lamps OK Parking lights switched on. Failure of one lamp	less than 20 Ω greater than 20 Ω
20	19	23	Stop-lamp switch and ignition and starting switch "radio" position	Ignition and starting switch in radio position	greater than 11,5 V
21	20	24	Bulb monitoring unit term. 54 L	Ign. and starting switch "radio" pos. Both stop lamps OK Brake pedal depressed. Failure of one lamp	less than 20 Ω greater than 20 Ω
22	21	25	Stop-lamp switch and bulb monitoring unit term. 54	Ignition and starting switch in "radio" position. Brake pedal depressed	greater than 11,5 V
23	22	26	Bulb monitoring unit term. KKL	Parking lights switched on. Both licence-plate lamps OK Failure of one lamp	less than 20 Ω greater than 20 Ω

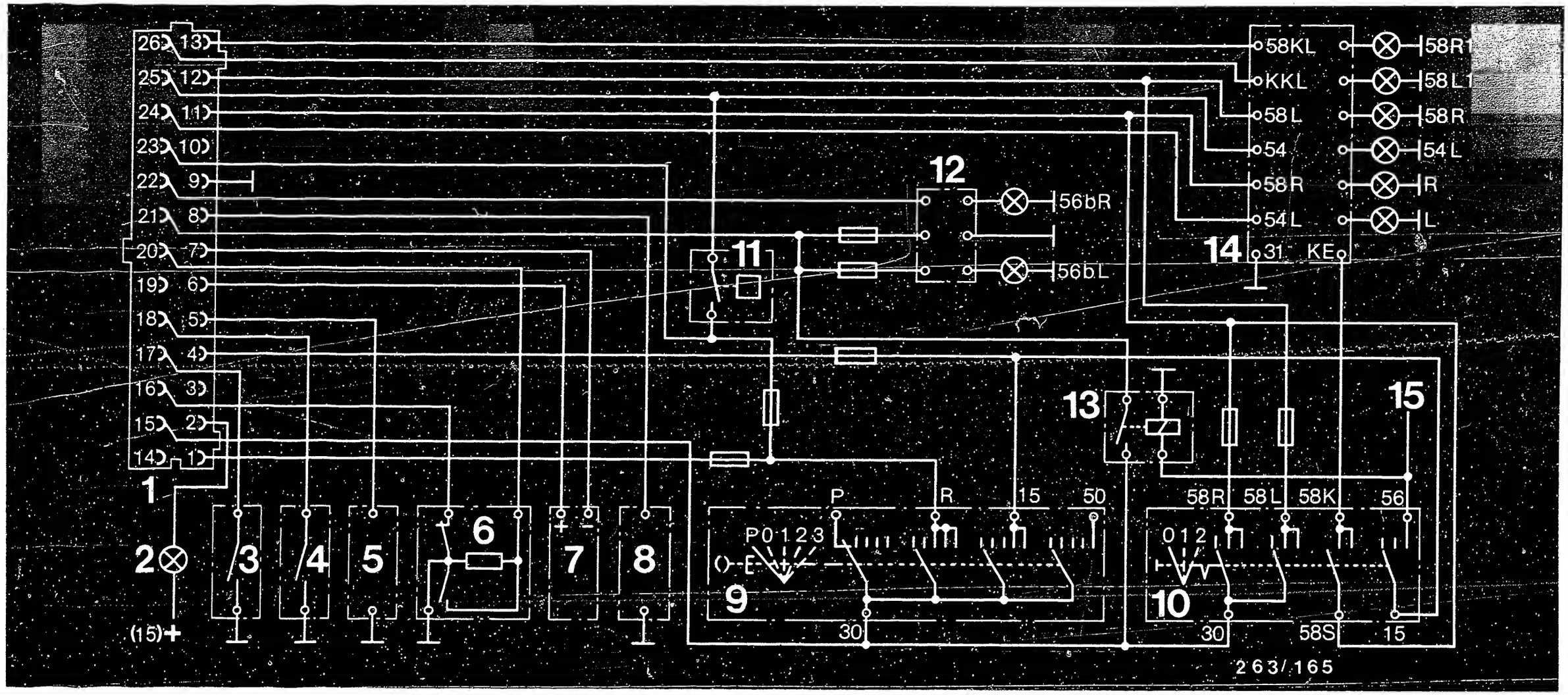
TEST SPECIFICATIONS

Supply voltage greater than or equal to 11,5 V

Resistance values

Coolant sensor	< 20 Ω
Washer-fluid sensor	< 20 Ω
Oil-level sensor	1 k Ω

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

1 = Unit plug
2 = Central indicator lamp (CHECK)
3 = Washer-fluid sensor
4 = Coolant sensor
5 = O_2 sensor
6 = Oil-level sensor
7 = Air bag
8 = Fasten seat belts
9 = Ignition and starting switch

X = Instrument cluster plug connection

10 = Headlamp switch
11 = Stop-lamp switch
12 = Bulb monitoring unit (lower beam)
13 = Upper-beam relay
14 = Bulb monitoring unit (stop, tail, licence-plate lamps)
15 = To upper-beam switch

M13 ⟹

M14 ⟸

INSTALLATION POSITION OF COMPONENTS

Bulb monitoring unit for lower beam:

In engine compartment on left as viewed from direction of travel, next to fuse box.

Bulb monitoring unit for stop lamps, tail lamps, licence-plate lamps:

In trunk behind rear panel covering, on left in direction of travel, next to central strut.

Coolant sensor:

In engine compartment on left in direction of travel, on expansion tank.

Washer-flud sensor:

In engine compartment on right in direction of travel, in the front side of the washer-fluid reservoir.

Oil-level sensor:

In direction of travel in engine compartment at the lowest point of the oil pan.

Fasten seat belt sensor:

In seat belt buckle

O_2 - sensor:

In exhaust manifold or in Y-tube of exhaust system.

Air bag sensor:

Not yet determined.

For production reasons:
continued on the following coordinate.